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ELEVATED TEMPERATURE PROPERTIES OF CAST ALUMINUM ALLOYS A201-T7 AND A357-T6

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The tensile, fatigue, fracture toughness, and fatigue crack growth properties of cast aluminum alloys A201-T7 and A357-T6 were evaluated at 250°F and 400°F. The tensile strength of A201-T7 decreased slightly at 250°F and dropped markedly at 400°F. The A201-T7 elongation increased as temperature increased. The tensile strength of A357-T6 decreased as test temperature increased. A357-T6 ductility increased then decreased as temperature increased. Valid fracture toughness values were difficult to obtain for both alloys. A201-T7 had an average K_{Ic} of 22.3 ksi in at 250°F and an average K_Q of 25.0 ksi in at 400°F. For A357-T6 K_Q values were 27.5 ksi in and 18.1 ksi in at 250°F and 400°F, respectively. Constant load amplitude fatigue strength decreased for both alloys. At low Ks, fatigue crack growth resistance decreased as test temperature increased.

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PREFACE

This report was prepared by the Materials Integrity Branch (AFWAL/MLSA), Systems Support Division, Materials Laboratory, Air Force Wright Aeronautical Laboratories, Wright Patterson Air Force Base, Ohio, under Project 2418, "Aerospace Structural Materials," Task 241807, "Systems Support," Work Unit 24180703, "Engineering and Design Data."

The work herein was performed between December 1982 and December 1984. The report was released in August 1985.

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SECTION I

BACKGROUND

In the past, little emphasis has been placed on the durability and damage tolerance of cast aluminum alloys A201-T7 and A357-T6. However, several systems originated requests for such data demonstrate that not only are aluminum castings being used, but their use is also desired in critical applications where damage tolerance design data is required. Both the aerospace industry and the Air Force are aware of this data need which must be filled before aerospace structural castings can be used in fracture critical applications. Northrop Corporation, under Air Force contract, developed much of the technology and data base to get cast aluminum data into MIL-HBK-5.[1-2] A part of this effort involved obtaining castings from several sources and developing an aluminum castings data base.

As part of this program, the Systems Support Division (AFWAL/MLSE) conducted fatigue crack growth testing.[3] In addition, and in order to generate the data requested by the System Program Offices, elevated temperature tests were added to the program. These tests included tensile, plane strain fracture toughness, constant-load-amplitude fatigue crack growth, and constant-load-amplitude-fatigue.
This report contains the the data generated for A201-T7 and A357-T6 at 250°F and 400°F.

SECTION II

TEST PROGRAM AND PROCEDURES

A. The materials evaluated in this program were the aluminum casting alloys A201-T7 and A357-T6. A201 is an aluminum-copper-silver alloy and A357 is an aluminum-silicon-magnesium alloy (Table I). Both alloys have respectable properties and are commonly used in aerospace applications. For this program test plates were cast and heat treated to Mil-A-21180 requirements (Figure 1 and Table II).

The A201 plates were x-ray Grade "B" in the designated areas and x-ray Grade "C" in the non-designated areas. Surface penetrant inspection revealed no linear surface defects, and attached tensile coupons confirmed the heat treatment with tensile values of 60 ksi ultimate tensile strength (UTS) and 55 ksi yield tensile strength (YTS). Also, the minimum plate hardness was Rockwell B 70, and the minimum plate conductivity was 31% IAC.

The A357 plates were also x-ray Grade "B" and "C" in the designated and non-designated areas, respectively. The plate had no linear defects and met the specified tensile requirements.

B. Test specimens were excised from the designated areas of the castings and machined to the dimensions shown in Figures 2-4. The thicknesses (B), for both the fracture toughness and the fatigue crack growth specimens, were machined as thick as possible while maintaining the required surface finish.

TABLE I

Average Chemistries of Step Plates.

	A201-T7	A357-T6
Copper	4.7	0.01
Silicon	0.08	6.87
Iron	0.04	0.07
Manganese	0.3	0.01
Zinc	--	0.01
Magnesium	0.3	0.53
Titanium	0.24	0.17
Beryllium	--	0.029*
Silver	0.45	--
Aluminum	Balance	Balance

* Slightly lower than MIL-21180C chemical composition limits.

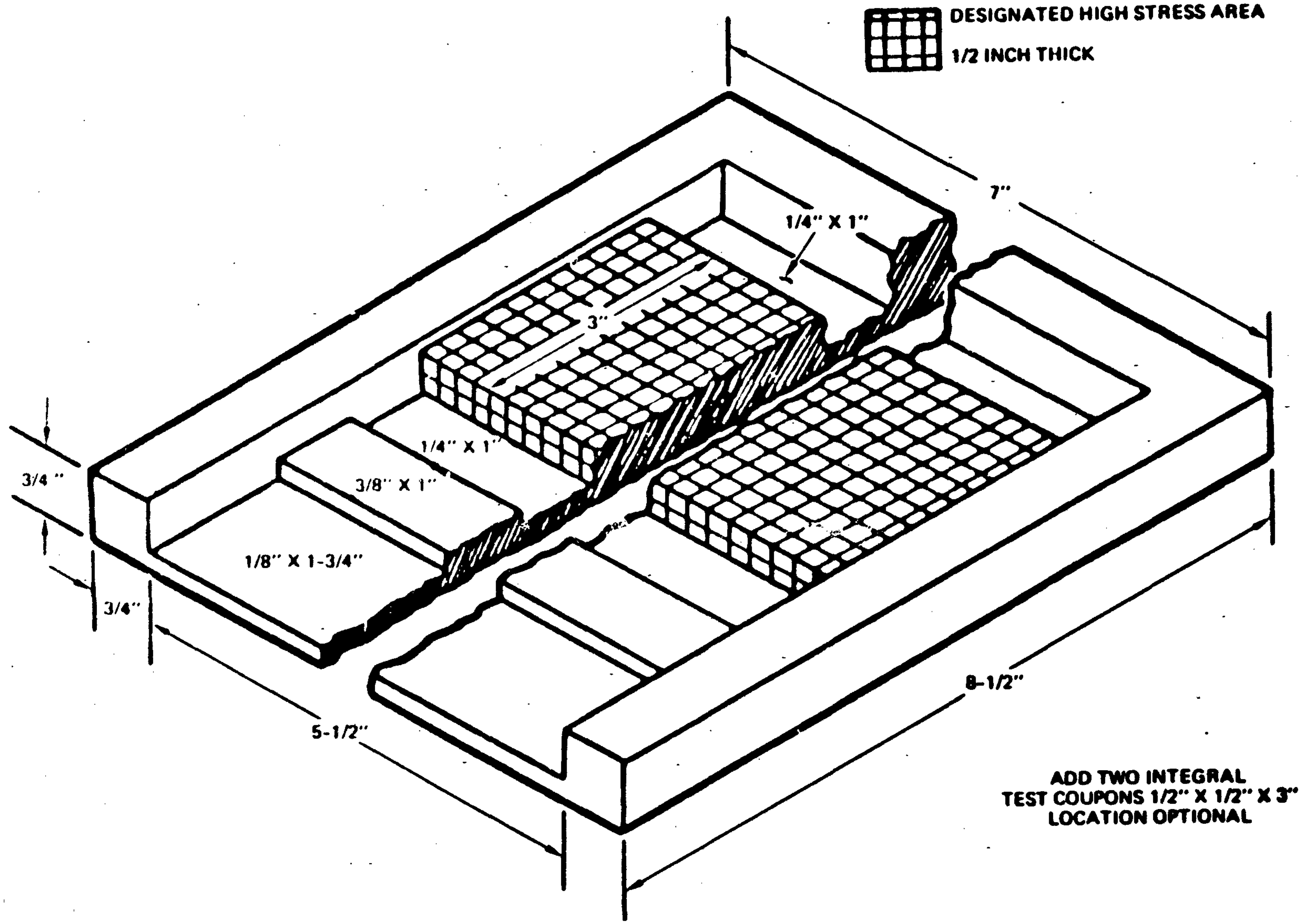


Figure 1: Step plate casting.

TABLE II

Heat Treatments

SUPPLIER	A201-T7	A357-T6
A	-Solutionize @ 940°F, 1 hr. @ 960°F, 1 hr. @ 980°F, 12 hrs. -Water quench @ room temp. -Age @ 370°F, 5 hrs.	-------
B	-Solutionize @ 920°F, 2 hrs. @ 940°F, 2 hrs. @ 960°F, 2 hrs. @ 980°F, 18 hrs. -Water quench @ room temp. -Age @ 310°F, 5 hrs.	-------
C	-------	-Solutionize @ 1010°f, 12 hrs. -Water quench @ romm temp. -Age @ 330°F, 5 hrs.
D	-------	-Solutionize @ 1010°F, 16 hrs. -Water quench @ room temp. -Age @ 340°F, 6 hrs.

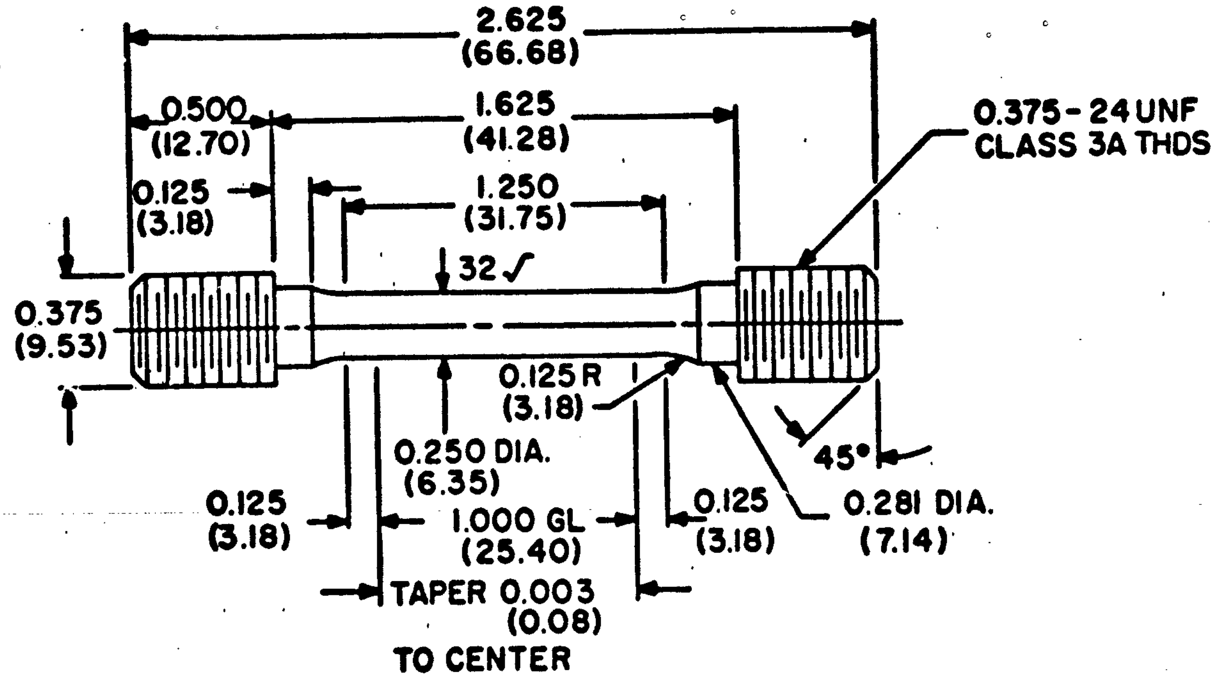


Figure 2: Tensile test specimen.

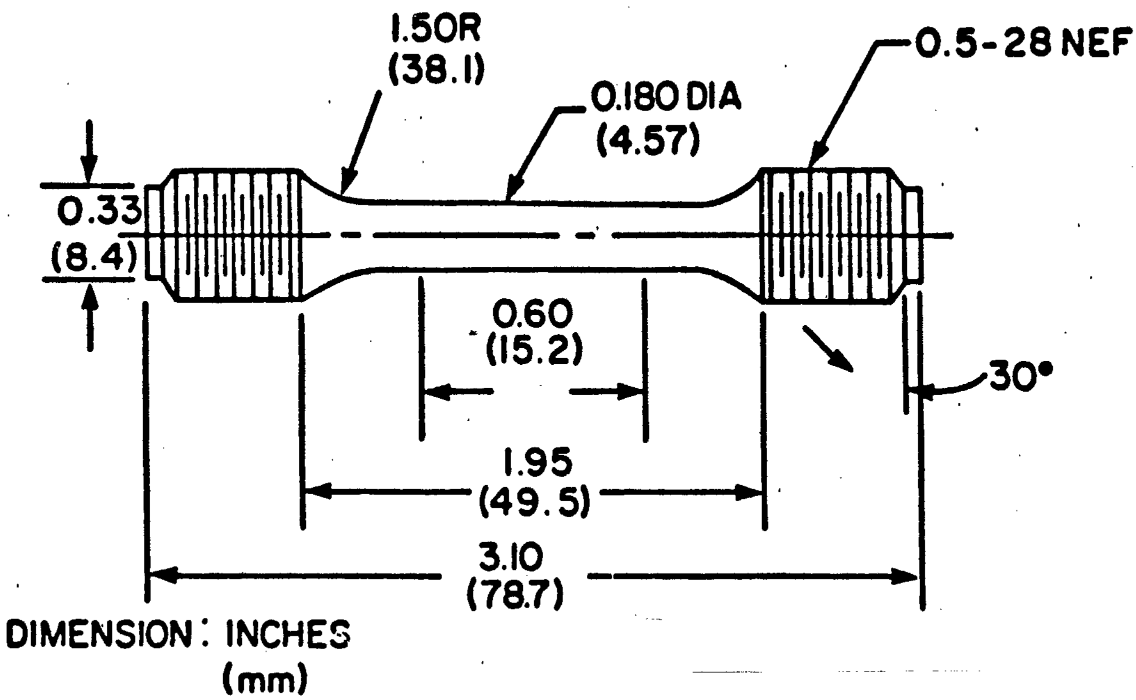
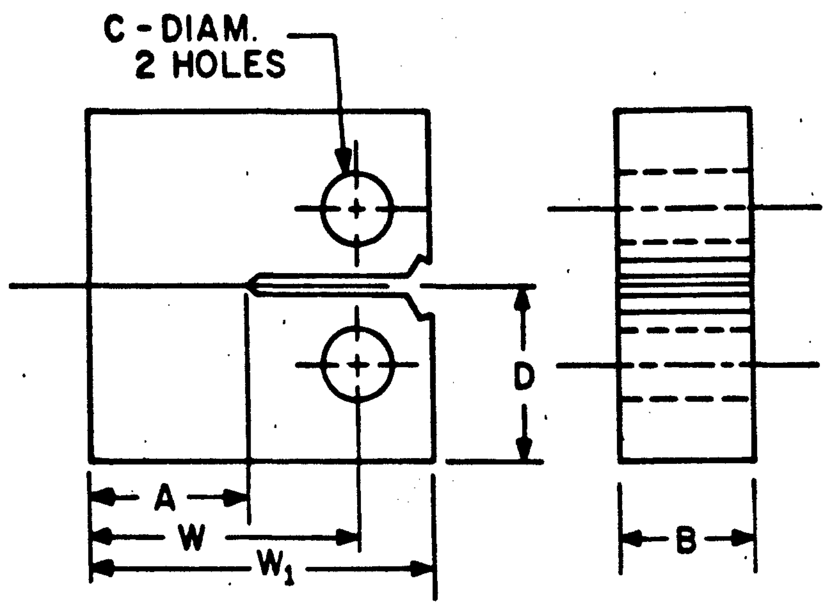


Figure 3: Fatigue test specimen.



	B	A	W	W1	D	C
Fracture Toughness	0.500 (12.7)	0.625 (15.9)	1.000 (25.4)	1.250 (31.8)	0.600 (15.2)	0.25 (6.4)
Fatigue Crack Growth	0.50 (12.7)	1.50 (38.1)	2.000 (50.8)	2.500 (63.5)	1.200 (30.5)	0.50 (12.7)

DIMENSIONS IN INCHES (mm)

Figure 4: Fracture toughness and fatigue crack growth specimens.

C. The test procedures are briefly described as follows:

Tensile tests were conducted in accordance with ASTM Test Methods B 557 and E 21. Tests were performed on a 10 kip Instron tensile test machine with a Conrad-Missimer environmental chamber.

Plane strain fracture toughness test specimens were precracked on a 2.2 kip MTS axial electrohydraulic fatigue machine and then pulled on 10 kip tensile test machine with the specimen in a Conrad-Missimer environmental chamber. Tests were governed by ASTM Test Method E 399.

Fatigue crack growth specimens were tested as outlined in ASTM Test Method E 647. Tests were conducted on an MTS axial fatigue machine and Conrad-Missimer convection heating chamber.

Constant-load-amplitude fatigue tests were conducted as outlined in ASTM Test Method E 466. Tests were conducted on a 2.2 kip MTS axial fatigue machine with a split furnace surrounding the specimen and grips.

All tests were conducted in air while test temperatures were kept within ± 2.5° F.

SECTION III

RESULTS AND DISCUSSION

A. Tensile test results for A201-T7 were listed in Tables III and IV. A201-T7 room temperature tensile properties for the step plate castings were 65.1 ksi UTS,60.0 ksi YTS, and 4.8% elongation.[4] At 250°F, A201-T7 averaged 59.1 ksi UTS, 54.6 ksi YTS and 9.3% elongation. At 400°F the A201-T7 tensile properties were 47.2 ksi UTS, 44.2 ksi YTS, and 11.8% elongation.Tensile test results for A357-T6 were listed in Tables V and VI. Room temperature tensile properties for A357-T6 step plate castings were of 48.8 ksi UTS, 41.1 ksi YTS, and 5.6% elongation.[5] At 250°F the average tensile strength decreased to 43.3 ksi, the average yield strength dropped slightly to 39.3 ksi, and the average elongation increased to 10.1%. At 400°F, the average ultimate strength nearly equaled the average yield strength at 35.8 and 35.3 ksi, respectively. Also the elongation dropped off from 10.1% at 250°F to 8.0% at 400°F.

B. Fracture toughness test data were listed in Tables VII-X. Of the twenty tests conducted, only three produced valid K_{Ic} values. A201-T7 had a wider range of K_Q values than A357-T6; however, three of the A201-T7 values were valid. The average K_{Ic} value for A201-T7 at 250°F was 22.3 ksi$\sqrt{in}$ while the average K_Q value for A201-T7 at 400°F was 25.0 ksi$\sqrt{in}$. At 250°F and 400°F, the average K_Q values for A357-T6 were 22.5 and 18.1 ksi$\sqrt{in}$, respectively. It was noted that the same problems occurred in this test program as those which occurred in the CAST Program. K_{Ic} values were not obtained because of thickness, crack length, crack curvature, and/or P_{max}/P_Q requirements.[6]

TABLF III Tensile Test Results for A201-T7 at 250°F

Specimen	Ultimate Strength ksi	Ultimate Strength MPa	Yield Strength (0.2% offset) ksi	Yield Strength (0.2% offset) MPa	% Elongation (1 in Gage Section)	% Reduction of Area
2LT1	59.0	406.8	55.3	381.3	11.5	28.4
2LT2	62.2	428.9	57.7	397.8	4.0	7.0
2LT3	54.7	377.2	50.2	346.1	9.7	29.1
2LT4	59.6	410.9	55.1	379.9	11.9	25.9
2LT5	59.2	408.2	54.1	373.0	9.3	21.8
2LT6	59.8	412.3	55.2	380.6	9.1	21.6
Average	59.1	407.4	54.6	376.5	9.3	22.3

TABLE IV Tensile Test Results for A201-T7 at 400°F

Specimen	Ultimate Strength ksi	Ultimate Strength MPa	Yield Strength (0.2% offset) ksi	Yield Strength (0.2% offset) MPa	% Elongation (1 in Gage Section)	% Reduction of Area
2HT1*	--	--	--	--	--	--
2HT2	48.0	331.0	45.0	310.3	12.4	36.5
2HT3	46.1	317.9	43.5	299.9	12.9	35.3
2HT4	49.3	339.9	45.8	315.8	10.0	29.5
2HT5	45.7	315.1	42.7	294.4	11.3	33.1
2HT6	46.8	322.7	43.8	302.0	12.3	37.8
Average	47.2	325.3	44.2	304.5	11.8	34.4

* Failed in set up.

TABLE V Tensile Test Results for A357-T6 at 250°F

Specimen	Ultimate Strength ksi	Ultimate Strength MPa	Yield Strength (0.2% offset) ksi	Yield Strength (0.2% offset) MPa	% Elongation (1 in Gage Section)	% Reduction of Area
3LT1	43.3	298.6	39.1	269.6	9.7	17.4
3LT2	43.3	298.6	39.1	269.6	10.9	18.2
3LT3	43.3	298.6	39.3	271.0	10.8	16.8
3LT4	42.9	295.8	*	*	7.2	11.6
3LT5	42.9	295.8	39.3	271.0	12.5	18.8
3LT6	43.5	299.9	39.6	273.0	9.3	16.3
Average	43.3	298.6	39.3	271.0	10.1	16.5

* Strain gage malfunctioned during test which prevented yield strength determination.

TABLE VI Tensile Test Results for A357-T6 at 400°F

Specimen	Ultimate Strength ksi	Ultimate Strength MPa	Yield Strength (0.2% offset) ksi	Yield Strength (0.2% offset) MPa	% Elongation (1 in Gage Section)	% Reduction of Area
3HT1*	--	--	--	--	--	--
3HT2	36.5	251.7	35.9	247.5	8.0	19.6
3HT3	35.7	246.2	35.3	243.4	7.1	19.6
3HT4	36.1	248.9	35.7	246.2	8.1	21.8
3HT5	35.3	243.4	34.8	239.9	8.6	23.8
3HT6	35.3	243.4	34.6	238.6	8.3	22.4
Average	35.8	246.8	35.3	246.8	8.0	21.4

* Specimen not machined.

TABLE VII Fracture Toughness Test Results for A201-T7 at 250°F

Specimen	Thickness (B,in)	Width (W,in)	Crack Length (a,in)	P_{max}/P_Q	K_{Ic} Ksi $\sqrt{in}$	K_{Ic} MPa $\sqrt{m}$	Comments
2LK1	0.4964	1.0010	0.4844	1.04	23.4	25.7	Valid
2LK2	0.4955	0.9997	0.4924	1.04	20.8	22.9	Valid
2LK3	0.4959	0.9996	0.4937	1.0	22.8	25.1	Valid
2LK4	0.4973	0.9983	0.4950	1.0	27.3 1	30.0	Invalid 1,2,3
2LK5	0.4961	0.9982	0.4879	1.06	27.3 1	30.0	Invalid 1,2,3
Average	K_{Ic}=22.3 ksi$\sqrt{in}$	K_Q=27.3 ksi$\sqrt{in}$,	K_{Ic}=24.6 MPa$\sqrt{m}$	K_Q=30 MPa$\sqrt{m}$			

1 K_Q
2 Exceeds thickness (B) requirement
3 Exceeds crack length (a) requirement

TABLE VIII Fracture Toughness Test Results for A201-T7 at 400°F

Specimen	Thickness (B,in)	Width (W,in)	Crack Length (a,in)	P_{max}/P_Q	K_Q Ksi $\sqrt{in}$	K_Q MPa $\sqrt{m}$	Comments
2HK1	0.4968	0.9994	0.5037	1.0	22.1	24.3	Invalid 1,2
2HK2	0.4969	0.9984	0.5092	1.11	27.9	30.7	Invalid 1,2,3
2HK3	0.4962	0.9981	0.4908	1.12	28.1	30.9	Invalid 1,2,3
2HK4	0.4969	0.9997	0.4938	1.14	29.0	31.9	Invalid 1,2,3
2HK5	0.4982	1.0010	0.5060	1.2	27.0	29.7	Invalid 1,2,3
Average					25.0	29.5	

1 Violates thickness (B) requirement
2 Violates crack length (a) requirement
3 P_{max}/P_Q greater than 1.1

TABLE IX Fracture Toughness Test Results for A357-T6 at 250°F

Specimen	Thickness (B,in)	Width (W,in)	Crack Length (a,in)	Pmax/P_Q	K_Q Ksi $\sqrt{in}$	K_Q MPa $\sqrt{m}$	Comments
3LK1	0.4783	1.006	0.5705	1.07	21.7	23.7	Invalid 1,2,3
3LK2	0.4798	1.007	0.5409	1.07	23.9	26.1	Invalid 1,2,3
3LK3	0.4796	1.007	0.5477	1.04	21.6	23.5	Invalid 1,2,3
3LK4	0.4797	1.007	0.5392	1.07	22.3	24.3	Invalid 3
3LK5	0.4795	1.006	0.5600	1.12	23.0	25.1	Invalid 1,2,3,4
Average					22.5	24.5	

1 Violates thickness (B) requirement
2 Violates crack length (a) requirement
3 Violates surface trace requirement
4 Violates crack front curvature requirement

TABLE X Fracture Toughness Test Results for A357-T6 at 400°F

Specimen	Thickness (B,in)	Width (W,in)	Crack Length (a,in)	Pmax/P_Q	K_Q Ksi $\sqrt{in}$	K_Q MPa $\sqrt{m}$	Comments
3HK1	0.4802	1.004	0.5196	1.06	18.3	19.9	Invalid 1,2
3HK2	0.4795	1.000	0.4989	1.11	17.6	19.2	Invalid 1,2
3HK3	0.4801	0.999	0.4972	1.19	18.3	19.9	Invalid 1,2
3HK4	0.4800	1.001	0.5428	1.09	17.6	19.2	Invalid 1,2
3HK5	0.4798	0.999	0.5072	1.17	18.7	20.4	Invalid 1,2
Average					18.1	19.7	

1 Violates thickness (B) requirement
2 Violates crack length (a) requirement

C. Constant-load-amplitude fatigue data were listed in Tables XI-XIV and plotted in Figures 5-7. The A201-T7 curves were fairly smooth (Figures 5 and 7a) and were in good agreement with data generated in earlier investigations.[7] There was a reduction in fatigue life for A201-T7 at both 250° and 400°F. The most significant reduction occurred at lives greater than 10^5 cycles. The fatigue endurance limit was approximately 14 ksi for A201-T7 at both temperatures.

The A357-T6 data exhibited more scatter than the A201-T7 data, but for the most part the A357-T6 fatigue curves were fairly smooth (Figures 6-7a). At 1×10^6 cycles there was little difference between the A357-T6 data at 250° and 400°F. The fatigue endurance limit was approximately 14 ksi. Although a room temperature data plot was constructed for A357-T6, these data can not be compared because of the different specimen configurations and R ratios.[8] In any event, A357-T6 has greater fatigue strength at 250° than at 400°F at below approximately 4×10^5 cycles. At lives greater than 1×10^6 cycles, the fatigue strength at both temperatures are nearly equal.

D. The constant-load-amplitude fatigue crack growth rate data were tabulated the Appendix and plotted in Figures 8-11. A201-T7 exhibited slightly faster growth at 400° than at 250°F at the lower stress intensity ranges. At the higher levels of stress intensity range, the crack growth rate data for both temperatures was nearly the same. Compared to other data, A201-T7 at 250° and 400°F had lower K_c values than room temperature data.[9] During the testing of A201-T7, it was noticed that there was good agreement between the automated crack length measurements and the manual measurements at 250°F. This also occurred at 400°F for specimen 2HC2, but most attempts at 400°F to measure cracks

automatically failed so manual measurements were made instead. The A357-T6 data also had faster crack growth rates at 400° than 250°F at the lower ranges of stress intensity. Both the 250° and 400°F fatigue crack growth rates were faster than at room temperature.[10]

TABLE XI Fatigue Data for A201-T7 at 250°F, R=0.1

SPECIMEN	MAXIMUM STRESS (ksi)	CYCLES
2LF1	18	4.70×10^{5}
2LF2	40	4.03×10^{4}
2LF3	20	3.88×10^{5}
2LF4	--	-------
2LF5	--	-------
2LF6	30	9.30×10^{4}
2LF7	45	1.30×10^{4}
2LF8	52	1.20×10^{4}
2LF9	15	1.60×10^{6}
2LF10	25	2.60×10^{5}
2LF11	60	1.10×10^{3}
2LF12*	14	1.05×10^{7}
2LF13	35	6.50×10^{4}
2LF14	56	8.10×10^{3}

*Runout

TABLE XII Fatigue Data for A201-T7 at 400°F, R=0.1

SPECIMEN	MAXIMUM STRESS (ksi)	CYCLES
2HF1	25	1.23×10^5
2HF2	18	4.37×10^5
2HF3	50	8.30×10^3
2HF4	40	1.56×10^4
2HF5	58	2.70×10^3
2HF6	54	4.30×10^3
2HF7	20	1.72×10^5
2HF8	45	1.23×10^4
2HF9	35	5.02×10^4
2HF10	30	5.34×10^4
2HF11**	16	1.60×10^6
2HF12	--	-------
2HF13*	15	1.00×10^7
2HF14	16	2.82×10^6

*Runout

**Failed in threads

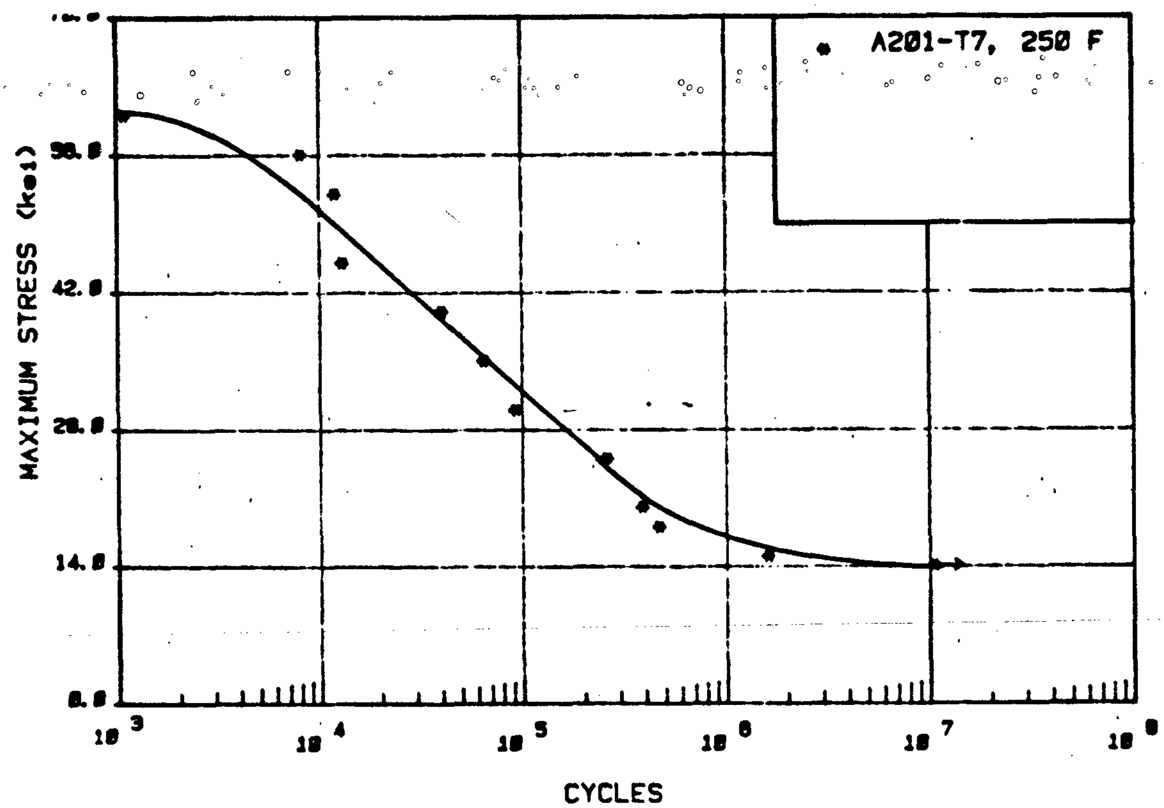
TABLE XIII Fatigue Data for A357-T6 at 250°F, R=0.1

SPECIMEN	MAXIMUM STRESS (ksi)	CYCLES
3LF1	50	2.00×10^{2}
3LF2	40	6.48×10^{4}
3LF3	30	4.63×10^{5}
3LF4	45	6.70×10^{3}
3LF5	35	3.93×10^{4}
3LF6	25	4.34×10^{5}
3LF7	20	1.37×10^{6}
3LF8*	15	1.01×10^{7}
3LF9	17.5	9.44×10^{5}
3LF10	32	2.45×10^{5}
3LF11	42	5.19×10^{4}
3LF12	34	1.38×10^{5}
3LF13*	16	1.70×10^{7}
3LF14	17	5.69×10^{5}

*Runout

TABLE XIV Fatigue Data for A357-T6 at 400°F, R=0.1

SPECIMEN	MAXIMUM STRESS (ksi)	CYCLES
3HF1	17	$5.17x10^6$
3HF2	20	$9.52x10^5$
3HF3	25	$2.01x10^5$
3HF4	35	$5.44x10^4$
3HF5	40	$1.01x10^4$
3HF6	45	$2.00x10^2$
3HF7	43	$2.00x10^2$
3HF8	41	$6.00x10^2$
3HF9	41	$5.80x10^3$
3HF10	16	$9.53x10^6$
3HF11	15	$6.44x10^5$
3HF12	15	$1.79x10^7$
3HF13	30	$6.17x10^4$
3HF14	37	$1.06x10^4$



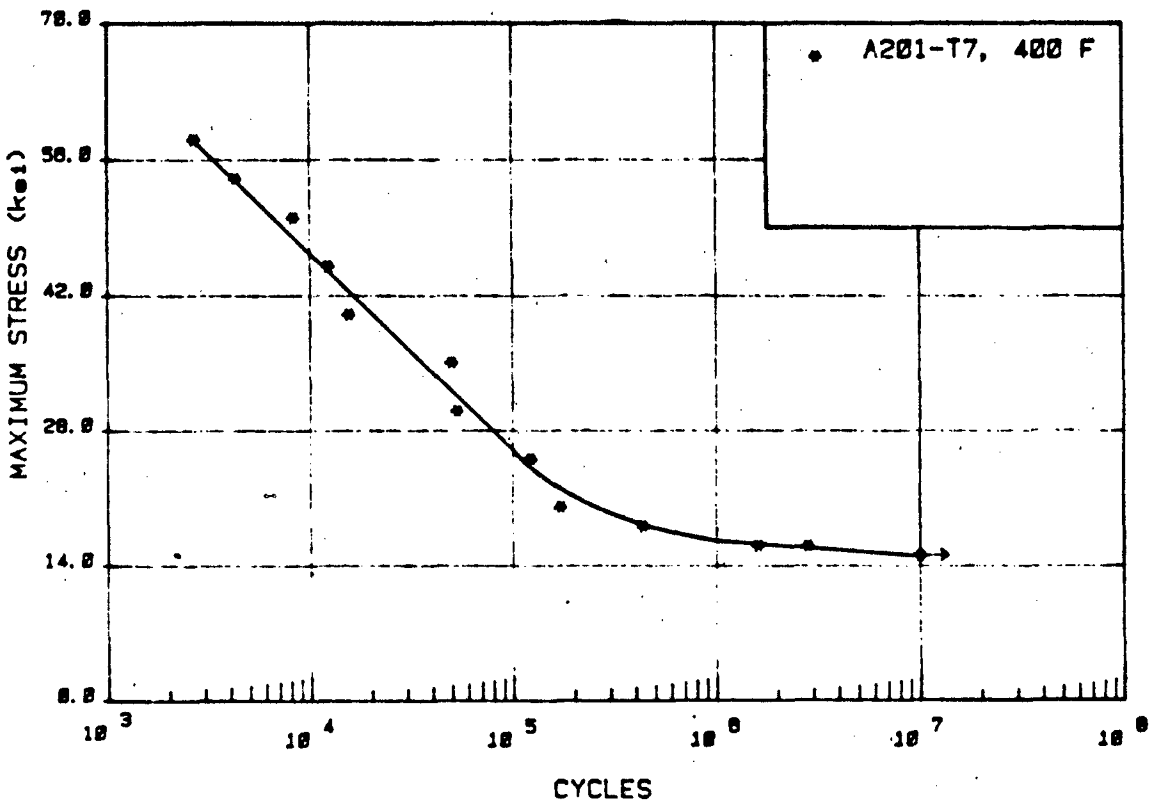
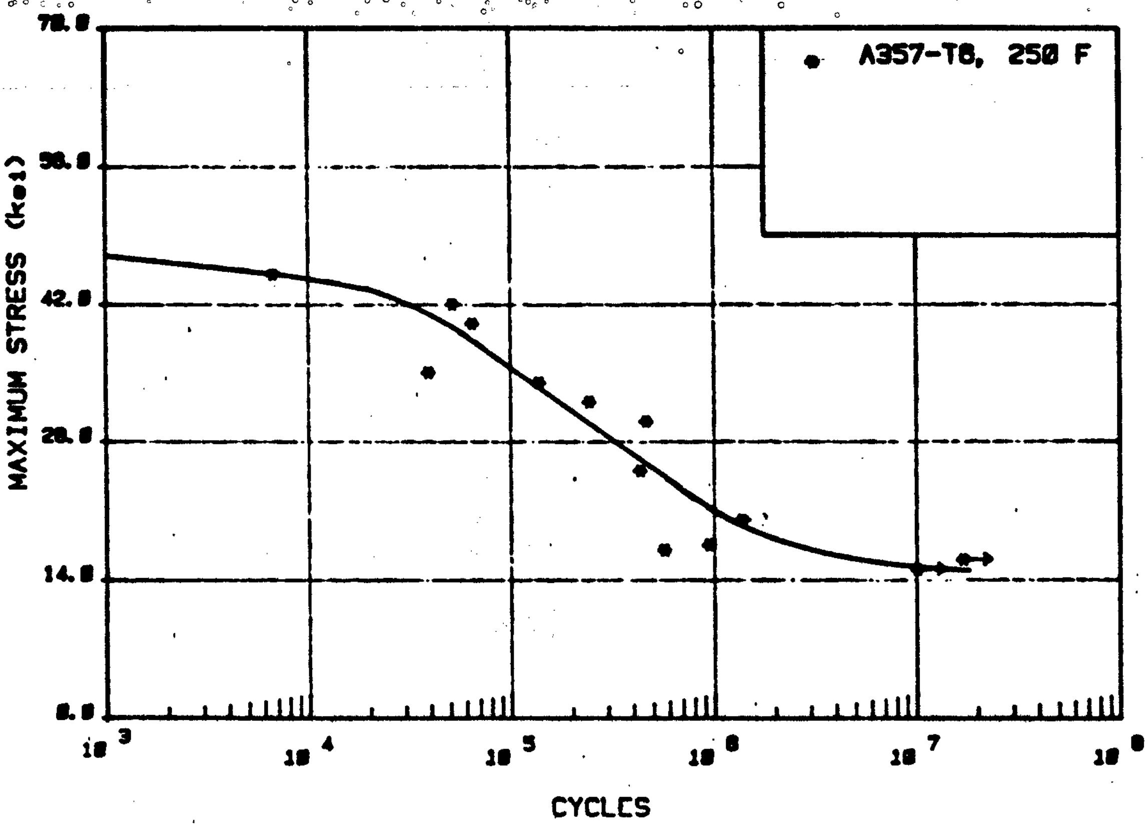


Figure 5: A201-T7 Fatigue Data, R=0.1, (a) 250°F, (b) 400°F.



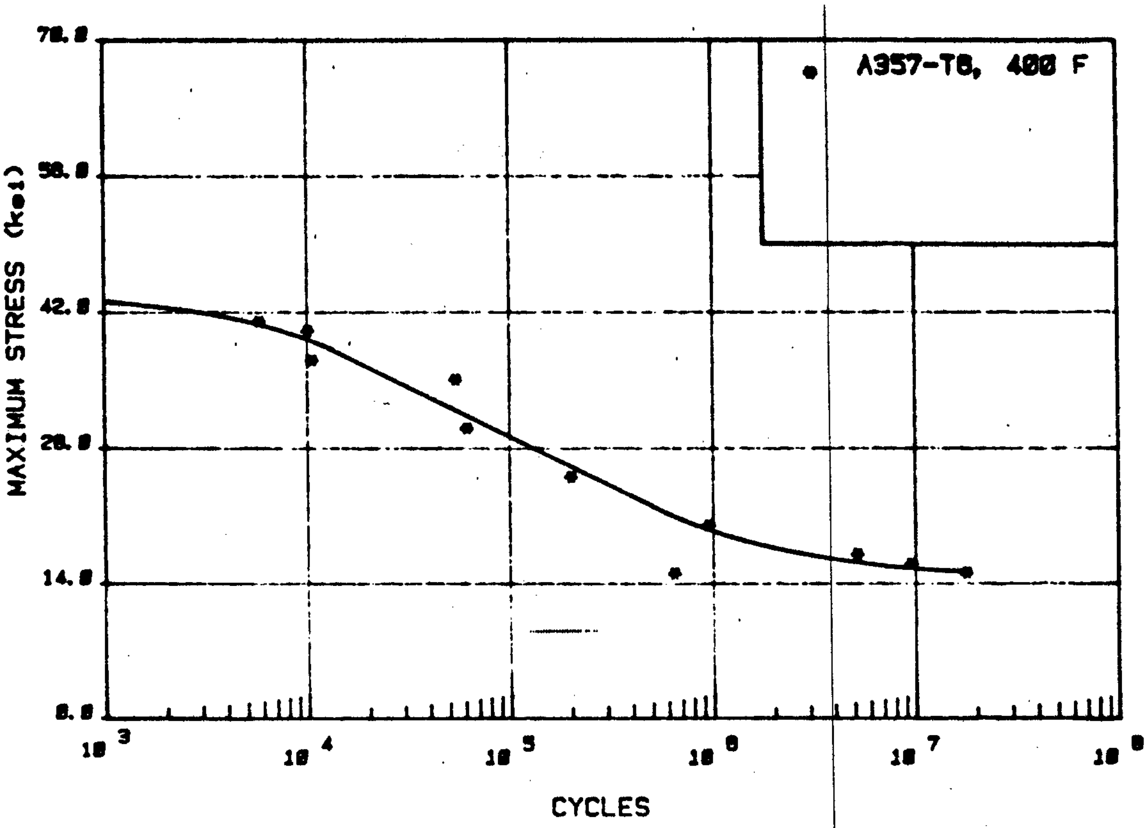


Figure 6: A357-T6 Fatigue Data, R=0.1 (a) 250°F, (b) 400°F.

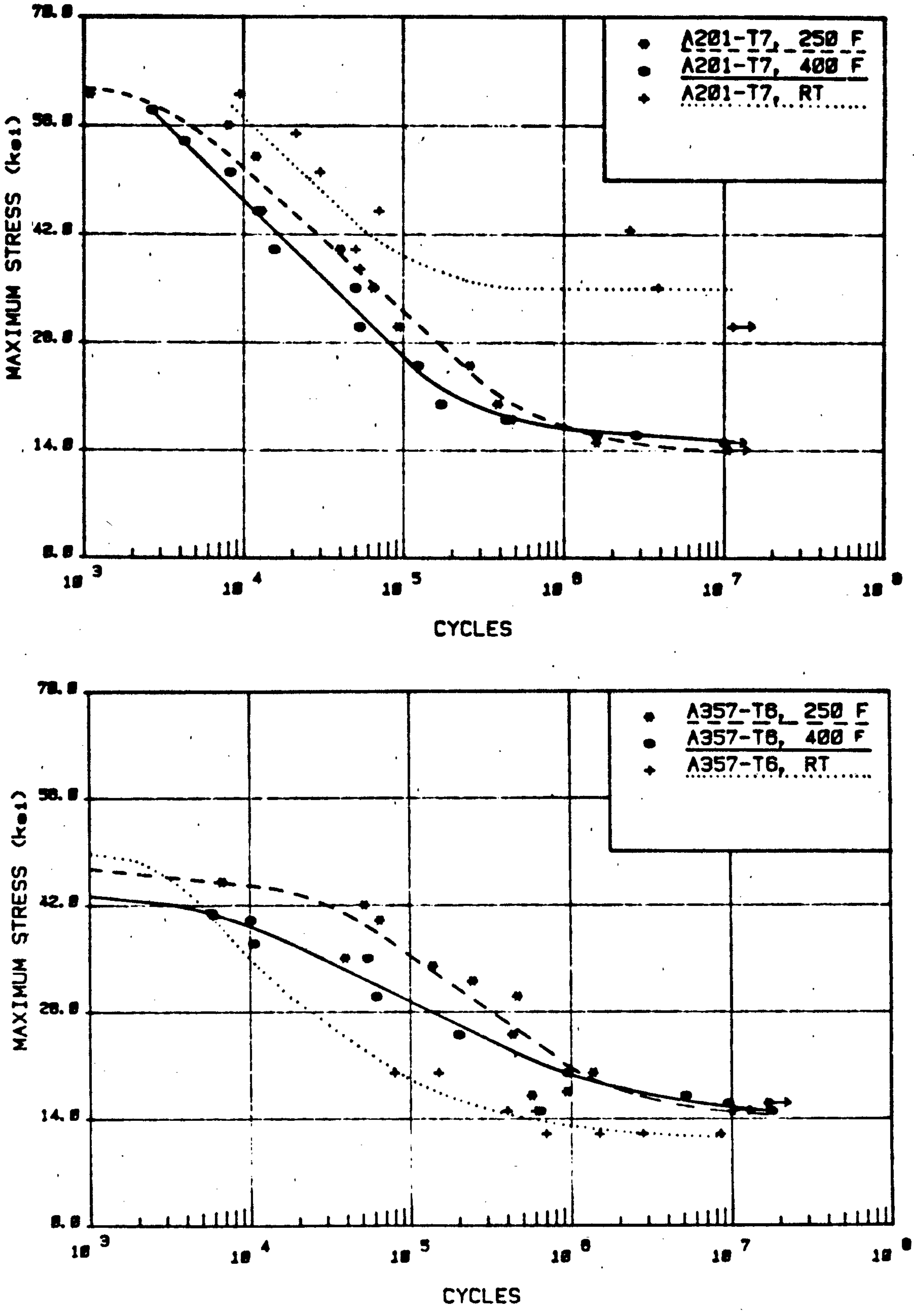


Figure 7: Combined plots of fatigue data, (a) 201-T7, (b) A357-T6.

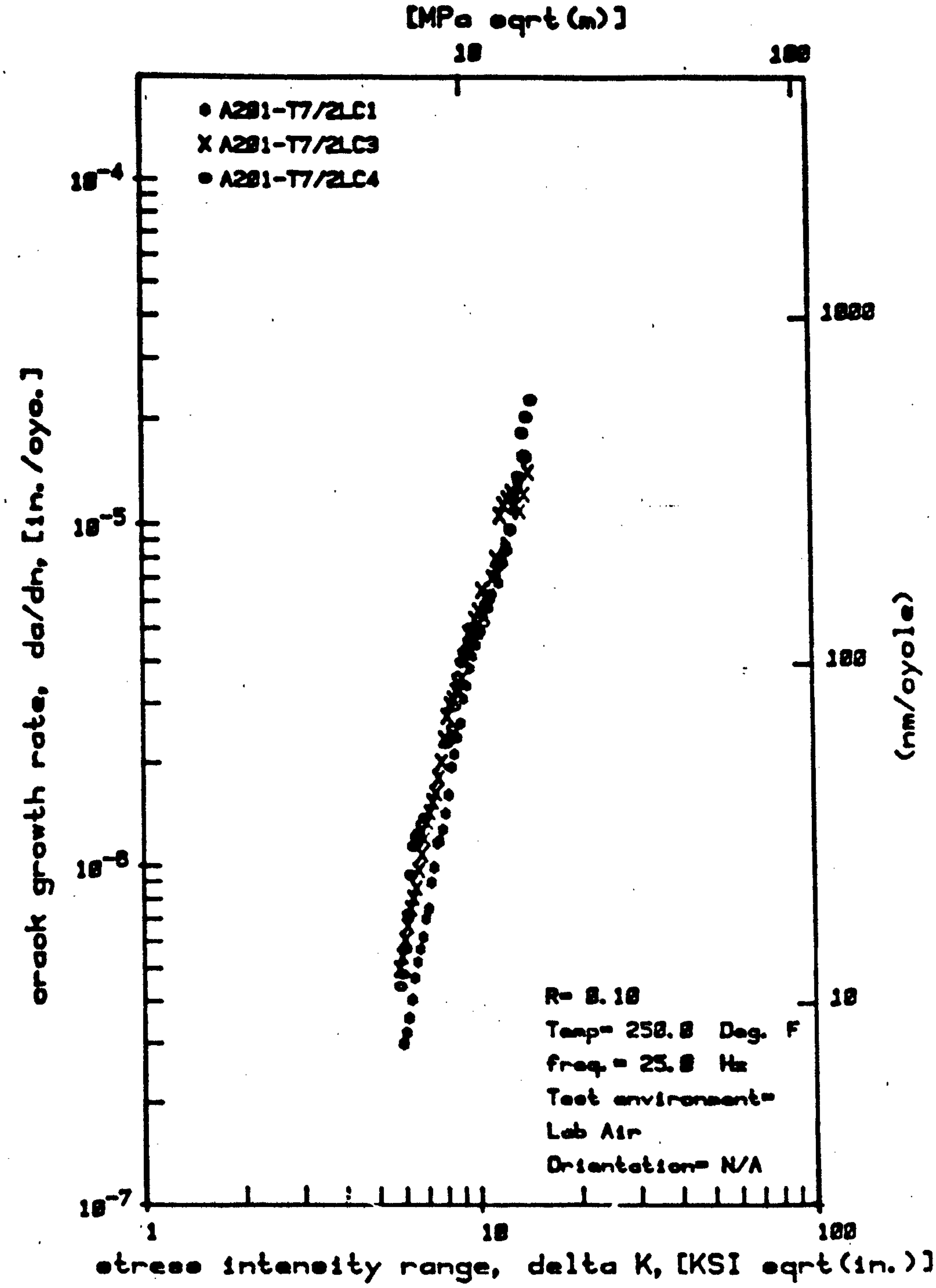


Figure 8: A201-T7 Fatigue Crack Growth Rate Data at 250°F.

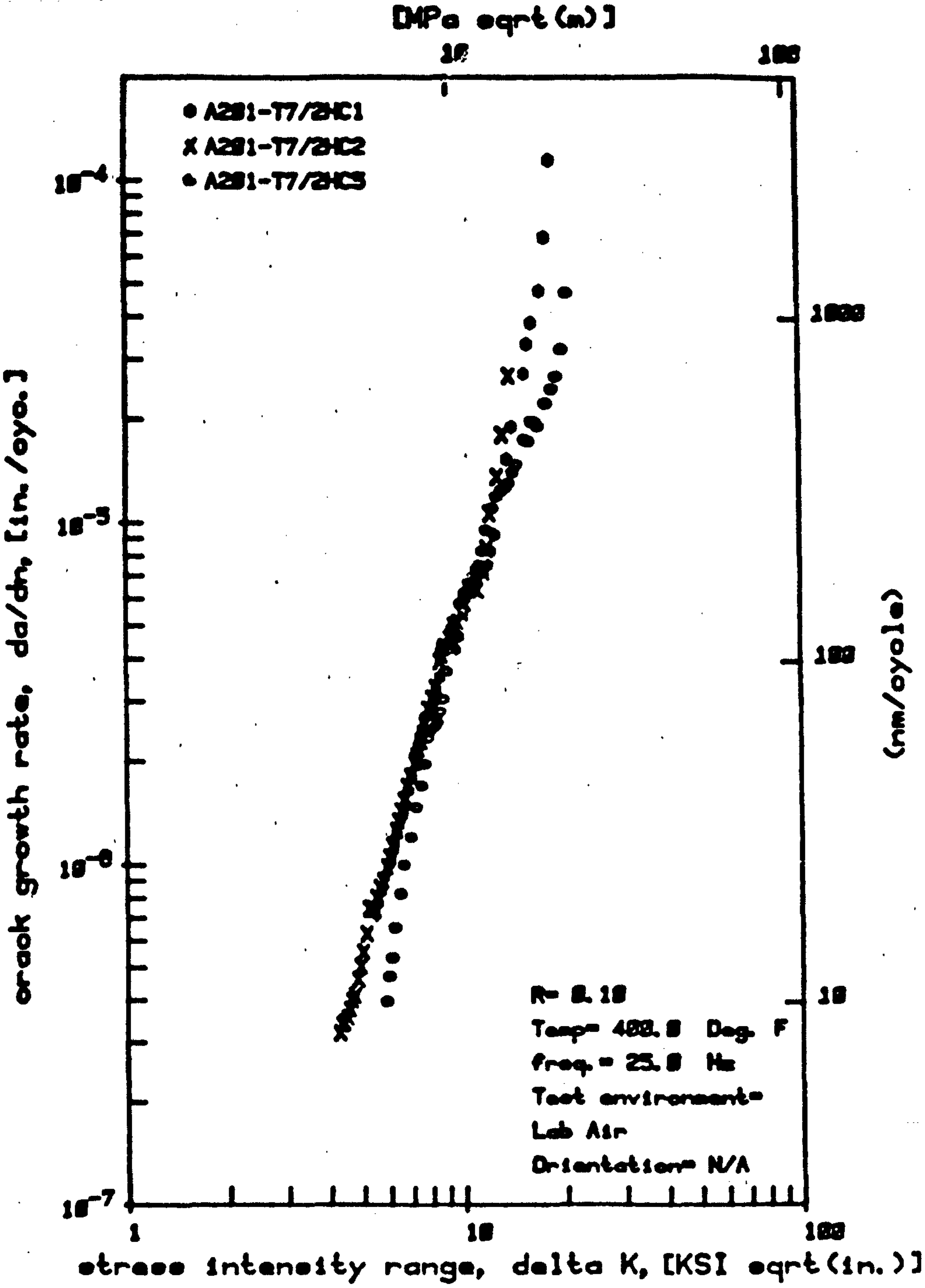


Figure 9: A201-T7 Fatigue Crack Growth Rate Data at 400°F.

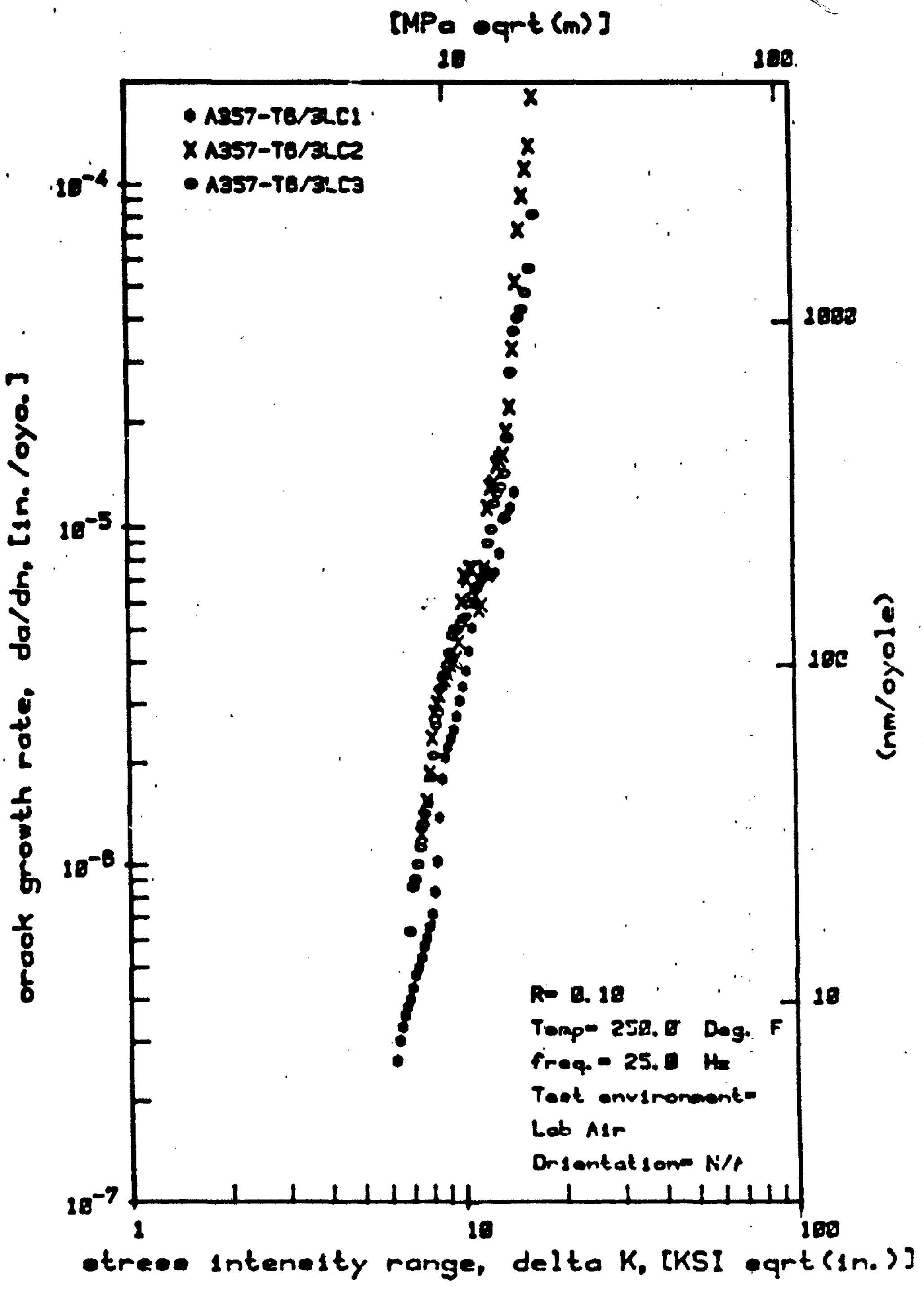


Figure 10: A357-T6 Fatigue Crack Growth Rate Data at 250°F.

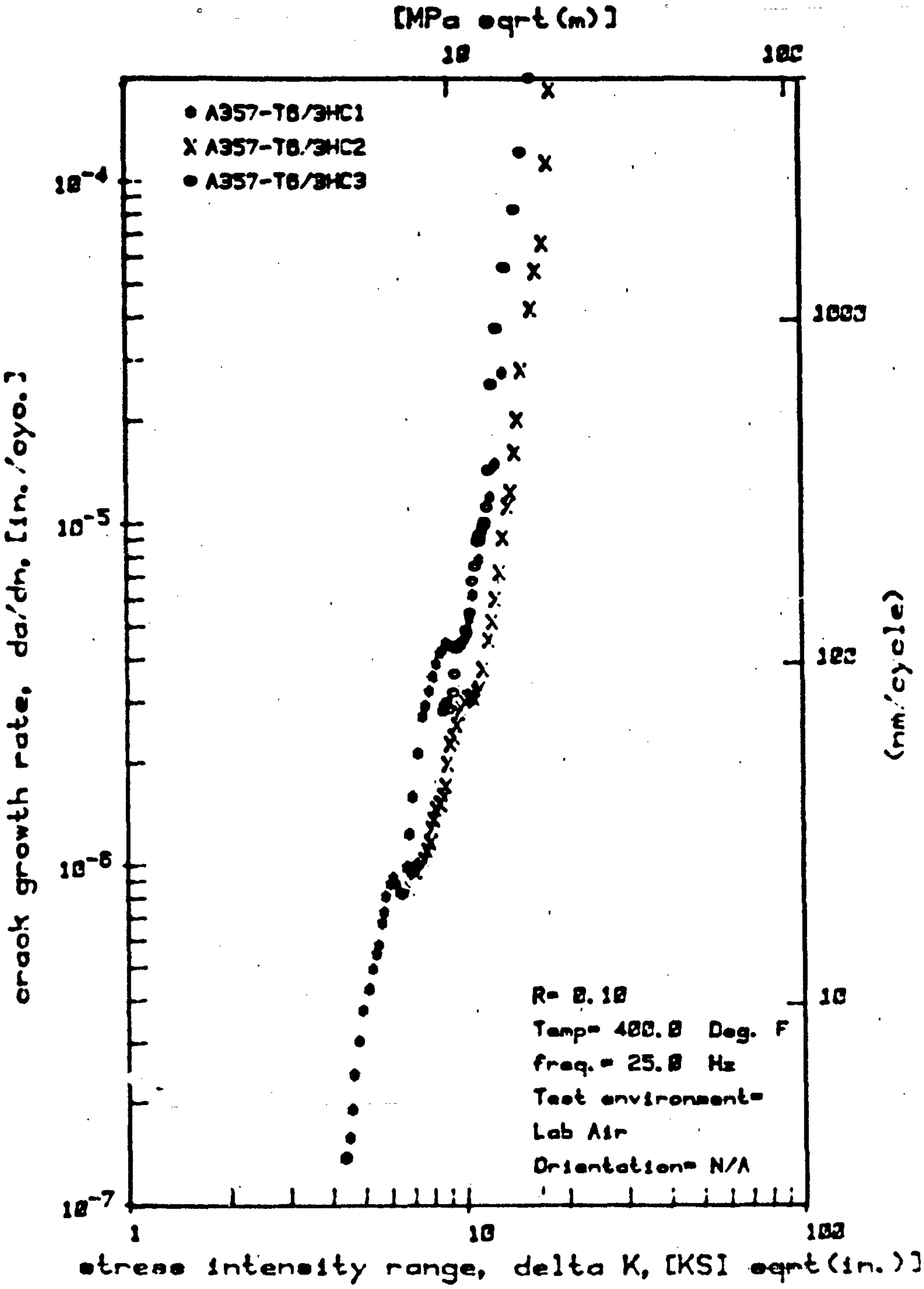


Figure 11: A357-T6 Fatigue Crack Growth Rate Data at 400°F.

SECTION IV

CONCLUSIONS

A. Tensile Properties

1. The ultimate tensile and yield strength of A201-T7 decreased slightly at 250°F and decreased markedly at 400°F. The percent elongation of A201-T7 increases as temperature increases.

2. The ultimate tensile and yield strengths of A357-T6 decrease with increasing temperature. The ultimate strength of A357-T6 at 400°F is slightly greater than the yield strength. The elongation of A357-T6 increases, then decreases, as temperature increases.

B. Fracture Toughness Properties

1. The average K_{Ic} for A201-T7 at 250°F is 22.3 ksi$\sqrt{in}$, while the average K_Q of A201-T7 at 400°F is 25.0 ksi$\sqrt{in}$.

2. The average K_Q for A357-T6 is 27.5 ksi$\sqrt{in}$ at 250°F and decreases to 18.1 ksi/in at 400°F.

C. Constant-Load-Amplitude Fatigue Properties

1. The fatigue strength of A201-T7 decreases as temperature increases from room temperature to 250° to 400°F. The fatigue endurance limit of A201-T7 at 250° and 400°F is approximately equal to 14 ksi.

2. The fatigue strength of A357-T6 decreases as temperature increases form 250° to 400°F. The fatigue endurance limit is approximately 15 ksi at both temperatures.

D. Fatigue Crack Growth Rate Properties

1. The fatigue crack growth rate of A201-T7 increases with increasing temperature at low ranges of delta K.

2. The fatigue crack growth rate of A357-T6 increases with increasing temperature at low ranges of delta K.

SECTION V

REFERENCES

1. K.J. Oswalt and C. Ford, "Manufacturing Methods for Process Effects on Aluminum Casting Allowables," Contract F33615-79-C-5116, IR 268-9(I), May 1981.

2. K.J. Oswalt, C. Ford, and Y. Lii, "Manufacturing Methods for Process Effects on Aluminum Casting Allowables," Contract F33615-79-C-5116, IR 268-9(II), May 1982.

3. J.D. Tirpak, "Constant-Load-Amplitude Fatigue Crack Growth Testing of Aluminum Casting Alloys A201-T7 and A357-T6," AFWAL-TR-85-4096, July 1985.

4. K.J. Oswalt and Y. Lii, "Manufacturing Methods for Process Efforts on Aluminum Casting Allowables," Contract F33615-79-C-5116, AFWAL-TR-84-4117, March 1985.

5. Oswalt, AFWAL-TR-84-4117, op.cit.

6. E.K. Gunther, "Cast Aluminum Structures Technology (CAST), Structural Test and Evaluation (Phase V), Part II-Fatigue and Fracture Properties of Cast Aluminum Bulkheads," Contract F33615-76-C-3111, AFWAL-TR-80-3021, Part II, April 1980.

7. O.L. Deel, P.E. Ruff, and H. Mindlin, "Engineering Data on New Aerospace Structural Materials," Contract F33615-73-C-5073, AFWAL-TR-75-97, June 1975.

8. "Premium Castings-Product Manual," Aluminum Company of America, 1972.

9. Tirpak, op.cit.

10. Tirpak, op.cit.

APPENDIX

FATIGUE CRACK GROWTH RATE DATA

19 JULY 1984

SPECIMEN NO. 2LC1 AUTOMATIC

Pmax = 775 LBF Pmin = 78 LBF R = 0.101

B=0.494 in. W=1.997 in.

PT #	CYCLE COUNT	A-cor in	A-req in	MC	deltaK KSI√in	da/dn μin/cy
1	0.001	0.592				
2	59.360	0.607				
3	119.490	0.622				
4	175.350	0.638	0.638	0.999299	5.90	0.2991
5	219.800	0.653	0.652	0.999295	6.02	0.3221
6	273.140	0.668	0.670	0.999186	6.13	0.3566
7	312.310	0.684	0.683	0.997877	6.26	0.4052
8	350.840	0.699	0.699	0.998766	6.38	0.4693
9	384.920	0.714	0.716	0.998586	6.51	0.5224
10	408.890	0.730	0.729	0.998781	6.64	0.5698
11	433.860	0.745	0.744	0.998920	6.77	0.6180
12	460.840	0.760	0.761	0.996632	6.91	0.7001
13	481.710	0.776	0.776	0.997739	7.05	0.7478
14	503.540	0.791	0.793	0.993495	7.19	0.8936
15	515.650	0.806	0.804	0.993358	7.34	0.9900
16	537.530	0.822	0.827	0.993870	7.50	1.1661
17	543.610	0.837	0.834	0.993189	7.65	1.1819
18	557.900	0.853	0.852	0.993457	7.82	1.2763
19	569.350	0.868	0.868	0.992763	7.98	1.4231
20	582.020	0.883	0.885	0.997968	8.15	1.6117
21	591.310	0.899	0.900	0.997926	8.33	1.9454
22	598.330	0.914	0.914	0.997982	8.51	2.1265
23	605.320	0.929	0.930	0.998380	8.69	2.3772
24	610.420	0.945	0.942	0.997328	8.90	2.6182
25	617.690	0.960	0.962	0.995875	9.10	3.0987
26	623.290	0.975	0.976	0.996263	9.30	3.3793
27	626.460	0.991	0.990	0.997490	9.53	3.8218
28	629.650	1.006	1.004	0.998219	9.76	4.1368
29	634.150	1.021	1.024	0.998248	9.99	4.4494
30	636.840	1.037	1.035	0.996597	10.25	4.8524
31	640.270	1.052	1.052	0.997430	10.50	5.4990
32	643.310	1.067	1.070	0.996462	10.76	5.8547
33	645.280	1.083	1.081	0.996873	11.05	6.1330
34	647.490	1.098	1.096	0.995836	11.34	6.7893
35	650.460	1.114	1.117	0.995628	11.66	7.5452
36	652.310	1.129	1.130	0.997922	11.97	8.0631
37	653.730	1.144	1.142	0.998209	12.30	[illegible].6702
38	655.670	1.160	1.160	0.998996	12.67	[illegible].6395
39	657.310	1.175	1.176	0.996140	13.04	10.9331
40	658.630	1.190	1.190	0.996123	13.42	13.0224
41	660.080	1.206	1.209	0.997572	13.84	15.6550
42	66[illegible].770	1.221	1.221	0.993170	14.27	15.6281
43	66[illegible].490	1.236				
44	[illegible]40	1.252				
45	6[illegible]80	1.267				

26 JULY 1984

SPECIMEN NO. 2LC3 AUTOMATIC

Pmax = 800 LBF Pmin = 80 LBF R = 0.100

B=0.492 in. W=1.996 in.

PT #	CYCLE COUNT	A-cor in	A-reg in	MC	delta K KSI√in	da/dn μin/cy
1	0.001	0.549				
2	46.8[illegible]0	0.564				
3	93.2[illegible]0	0.560				
4	126.6[illegible]0	0.595	0.596	0.999288	5.79	0.4981
5	152.7[illegible]0	0.611	0.610	0.999110	5.91	0.5416
6	181.4[illegible]0	0.626	0.626	0.999249	6.02	0.6050
7	204.1[illegible]0	0.641	0.640	0.998578	6.14	0.6647
8	230.630	0.657	0.658	0.999444	6.27	0.7494
9	248.920	0.672	0.672	0.999258	6.39	0.8044
10	265.6[illegible]0	0.687	0.687	0.995628	6.51	0.7974
11	283.1[illegible]0	0.703	0.703	0.980439	6.65	0.9001
12	300.6[illegible]0	0.718	0.718	0.973364	6.78	1.0231
13	324.740	0.733	0.744	0.974707	6.91	1.3253
14	324.740	0.749	0.743	0.977720	7.06	1.3826
15	337.410	0.764	0.762	0.971364	7.20	1.4940
16	347.800	0.779	0.781	0.977246	7.34	1.6676
17	354.930	0.795	0.791	0.995954	7.49	1.6280
18	367.670	0.810	0.813	0.996004	7.64	1.8045
19	374.210	0.825	0.825	0.993864	7.80	2.0143
20	381.670	0.841	0.839	0.996179	7.97	2.3561
21	389.700	0.856	0.860	0.996136	8.13	2.7451
22	393.850	0.872	0.871	0.997245	8.31	2.9807
23	398.280	0.887	0.885	0.995207	8.49	3.0960
24	403.460	0.902	0.904	0.999169	8.67	3.2634
25	407.590	0.918	0.916	0.997932	8.87	3.2872
26	412.940	0.933	0.933	0.997087	9.06	3.5478
27	417.690	0.948	0.950	0.996998	9.26	4.0431
28	421.150	0.964	0.964	0.998181	9.48	4.8254
29	424.300	0.979	0.980	0.991814	9.70	4.9028
30	427.060	0.994	0.995	0.993555	9.92	5.2126
31	428.940	1.010	1.005	0.991808	10.17	5.6197
32	433.190	1.025	1.029	0.990352	10.41	6.4514
33	434.97[illegible]	1.040	1.041	0.986446	10.67	6.1632
34	437.070	1.056	1.054	0.987065	10.95	6.2171
35	438.810	1.071	1.067	0.969936	11.22	7.0077
36	442.2[illegible]0	1.086	1.089	0.980771	11.51	7.9697
37	444.3[illegible]0	1.102	1.105	0.988550	11.83	10.6003
38	445.6[illegible]0	1.117	1.118	0.991367	12.14	11.3675
39	446.5[illegible]0	1.133	1.130	0.991990	12.49	11.8114
40	447.6[illegible]0	1.148	1.147	0.997982	12.84	12.3366
41	449.170	1.163	1.164	0.994791	13.20	11.3359
42	450.490	1.179	1.176	0.992258	13.60	10.9097
43	452.570	1.194	1.198	0.994146	14.00	12.1749
44	453.510	1.209	1.209	0.994680	14.42	14.0806
45	454.4[illegible]0	1.225				
46	455.570	1.240				
47	456.180	1.255				

27 JULY 1984

SPECIMEN NO. 2LC3 MANUAL

Pmax = 800 LBF Pmin = 80 LBF R = 0.100

B=0.492 in. W=1.998 in.

PT #	CYCLE COUNT	Amcor in	Amreg in	MC	deltaK KSI√in	da/dn μin/cy
1	0.001	0.548				
2	55.000	0.574				
3	100.000	0.586				
4	140.000	0.619	0.615	0.992881	5.97	0.6406
5	170.000	0.633	0.634	0.994617	6.08	0.7363
6	200.000	0.654	0.658	0.995623	6.24	0.8369
7	225.000	0.681	0.679	0.995856	6.46	0.8780
8	250.000	0.704	0.703	0.998249	6.66	0.9363
9	270.000	0.724	0.723	0.998776	6.83	0.9708
10	290.000	0.740	0.741	0.998570	6.97	1.0197
11	310.000	0.761	0.761	0.998202	7.17	1.1581
12	325.000	0.778	0.778	0.999784	7.33	1.3033
13	340.000	0.798	0.799	0.999010	7.52	1.5314
14	355.000	0.823	0.823	0.999292	7.78	1.7463
15	370.000	0.849	0.851	0.999262	8.06	1.9995
16	380.000	0.874	0.872	0.999141	8.34	2.1598
17	390.000	0.893	0.894	0.998405	8.56	2.4068
18	395.000	0.906	0.906	0.997642	8.72	2.5789
19	400.000	0.918	0.919	0.999731	8.87	2.7978
20	405.000	0.934	0.933	0.999355	9.08	3.1500
21	410.000	0.949	0.950	0.999368	9.28	3.4357
22	415.000	0.967	0.968	0.999476	9.53	3.7698
23	420.000	0.989	0.987	0.999461	9.85	4.1086
24	425.000	1.008	1.009	0.999540	10.14	4.4184
25	428.000	1.022	1.022	0.999443	10.37	4.6304
26	431.000	1.037	1.036	0.998035	10.62	5.1170
27	434.000	1.051	1.051	0.998355	10.86	5.7071
28	437.000	1.067	1.069	0.998447	11.15	6.5524
29	439.000	1.084	1.082	0.999029	11.47	7.1927
30	443.000	1.112	1.114	0.998206	12.04	8.4126
31	445.000	1.133	1.132	0.998261	12.49	8.6680
32	446.500	1.147	1.145	0.997759	12.81	8.7496
33	448.000	1.158	1.159	0.997647	13.08	9.1841
34	449.500	1.172	1.171	0.997005	13.42	9.7729
35	451.000	1.185	1.186	0.998763	13.76	11.0946
36	452.500	1.202	1.204	0.996177	14.23	11.9873
37	453.500	1.218	1.216	0.991330	14.69	14.2120
38	454.500	1.232	1.232	0.987279	15.11	14.4928
39	455.[illegible]00	1.241	1.246	0.982879	15.39	16.1018
40	456.[illegible]00	1.269	1.262	0.981539	16.34	18.1135
41	458.[illegible]00	1.283	1.292	0.968876	16.85	28.2780
42	458.[illegible]00	1.304	1.305	0.972851	17.66	35.4830
43	[illegible]	1.318				
44	459.[illegible]00	1.350				
45	459.[illegible]00	1.363				

27 JULY 1984

SPECIMEN NO. 2LC4 AUTOMATIC

Pmax = 800 LBF Pmin = 80 LBF R = 0.100

B=0.491 in. W=1.998 in.

PT #	CYCLE COUNT	A-corr in	Amid in	MC	deltaK KSI√in	da/dn uin/cy
1	0.001	0.804				
2	2.310	0.819				
3	13.500	0.835				
4	19.320	0.850	0.848	0.997903	8.08	2.3457
5	40.460	0.896	0.899	0.996199	8.61	2.8785
6	45.360	0.912	0.912	0.997932	8.81	3.5068
7	49.800	0.927	0.928	0.999840	9.00	3.9334
8	53.250	0.942	0.942	0.999062	9.20	4.1506
9	59.990	0.973	0.972	0.998989	9.63	4.7181
10	62.960	0.988	0.987	0.999159	9.85	4.8519
11	66.810	1.004	1.006	0.999147	10.10	4.9375
12	69.040	1.019	1.017	0.998146	10.34	5.1027
13	72.270	1.034	1.034	0.998315	10.59	5.2917
14	78.390	1.065	1.067	0.997016	11.13	6.1316
15	80.270	1.080	1.078	0.998881	11.42	6.6794
16	83.140	1.096	1.098	0.997870	11.73	7.8343
17	84.670	1.111	1.109	0.998302	12.04	8.3159
18	88.480	1.142	1.144	0.998182	12.72	10.5949
19	90.980	1.173	1.172	0.996634	13.48	13.3318
20	92.420	1.188	1.193	0.993153	13.87	16.8559
21	93.140	1.203	1.205	0.993840	14.28	19.7414
22	93.940	1.219	1.220	0.995627	14.75	22.692
23	94.350	1.234				
24	95.150	1.250				
25	95.680	1.265				

27 JULY 1984

SPECIMEN NO. 2LC4 [illegible]

Pmax = 800 LBF Pmin = 80 LBF R = 0.100

B=0.491 in. W=1.998 in.

PT #	CYCLE COUNT	A-CRK in	AMEAN in	MC	DELTA K KSI-√in	da/dN μin/cy
1	0.001	0.548				
2	30.000	0.561				
3	120.000	0.611				
4	150.000	0.625	0.627	0.998657	6.12	0.6920
5	180.000	0.647	0.649	0.998598	6.20	0.7610
6	210.000	0.674	0.672	0.998822	6.42	0.6680
7	235.000	0.695	0.695	0.998995	6.59	0.9756
8	250.000	0.708	0.710	0.998719	6.71	1.0645
9	265.000	0.726	0.726	0.999504	6.86	1.1361
10	280.000	0.744	0.744	0.999246	7.02	1.2119
11	295.000	0.764	0.763	0.999244	7.21	1.3062
12	310.000	0.783	0.783	0.998438	7.39	1.4215
13	325.000	0.807	0.804	0.998452	7.58	1.6167
14	335.000	0.820	0.820	0.999639	7.76	1.7800
15	345.000	0.839	0.838	0.999673	7.96	2.0086
16	355.000	0.860	0.860	0.999686	8.19	2.2620
17	365.000	0.882	0.883	0.999746	8.45	2.5403
18	375.000	0.910	0.910	0.999849	8.79	2.8807
19	382.000	0.930	0.930	0.999619	9.04	3.2610
20	387.000	0.947	0.947	0.999591	9.27	3.5404
21	390.000	0.957	0.957	0.999673	9.41	3.7731
22	395.000	0.978	0.977	0.999297	9.70	4.2770
23	400.000	0.998	0.999	0.999661	10.01	4.8504
24	405.000	1.024	1.025	0.999228	10.42	5.3840
25	410.000	1.055	1.053	0.998542	10.95	6.1534
26	414.000	1.080	1.078	0.995834	11.42	7.2424
27	418.000	1.103	1.108	0.996613	11.87	8.4898
28	421.000	1.132	1.133	0.998204	12.50	10.1117
29	424.000	1.167	1.165	0.998479	12.33	12.5616
30	426.000	1.188	1.193	0.995576	13.87	15.0250
31	427.000	1.206	1.210	0.983829	14.37	20.6029
32	427.500	1.216				
33	428.000	1.229				
34	428.500	1.251				

17 JULY 1984

SPECIMEN NO. 2HC1 MANUAL

Pmax = 700 LBF Pmin = 70 LBF R = 0.100

B=0.494 in. W=2.053 in.

PT #	CYCLE COUNT	A-cor in	A-reg in	MC	deltaK KSI√in	da/dn uin/cy
1	0.001	0.561				
2	35.000	0.580				
3	65.000	0.596				
4	95.000	0.611	0.612	0.999424	4.97	0.5814
5	125.000	0.629	0.629	0.999770	5.09	0.6196
6	150.000	0.646	0.645	0.999717	5.20	0.6539
7	170.000	0.659	0.659	0.999596	5.28	0.6637
8	190.000	0.673	0.673	0.999245	5.37	0.6881
9	210.000	0.687	0.686	0.999227	5.47	0.7107
10	230.000	0.699	0.700	0.998384	5.55	0.7714
11	250.000	0.716	0.716	0.999172	5.67	0.8367
12	270.000	0.732	0.733	0.999220	5.79	0.9165
13	290.000	0.754	0.753	0.999512	5.95	0.9975
14	305.000	0.768	0.768	0.999506	6.05	1.0511
15	320.000	0.784	0.784	0.998757	6.18	1.1381
16	335.000	0.803	0.801	0.999608	6.31	1.2366
17	350.000	0.819	0.820	0.999623	6.46	1.3644
18	360.000	0.835	0.834	0.999541	6.60	1.4402
19	370.000	0.850	0.850	0.999385	6.73	1.4950
20	380.000	0.865	0.864	0.996988	6.86	1.6393
21	390.000	0.881	0.880	0.997655	7.01	1.7935
22	400.000	0.896	0.899	0.998446	7.15	2.0684
23	410.000	0.921	0.920	0.998354	7.39	2.3559
24	415.000	0.933	0.932	0.998110	7.52	2.4940
25	420.000	0.947	0.946	0.998791	7.66	2.6921
26	425.000	0.958	0.960	0.997928	7.78	2.7143
27	430.000	0.973	0.973	0.997961	7.95	2.8429
28	435.000	0.990	0.988	0.997855	8.15	2.9979
29	440.000	1.001	1.003	0.997562	8.28	3.2393
30	445.000	1.019	1.019	0.997980	8.50	3.5321
31	448.000	1.030	1.029	0.992854	8.64	4.3402
32	451.000	1.042	1.044	0.979399	8.80	4.3102
33	454.000	1.054	1.058	0.982323	8.96	4.3767
34	457.000	1.080	1.072	0.984021	9.34	4.4287
35	463.000	1.093	1.097	0.981757	9.53	4.2475
36	466.000	1.107	1.109	0.977700	9.75	4.6426
37	469.000	1.122	1.121	0.999209	9.99	5.4881
38	471.000	1.132	1.133	0.999495	10.16	6.0375
39	473.000	1.146	1.146	0.999264	10.41	6.4326
40	475.000	1.160	1.159	0.999429	10.66	6.9464
41	477.000	1.174	1.174	0.999723	10.93	7.3214
42	479.000	1.188	1.189	0.998361	11.20	7.2500
43	481.000	[illegible]	1.204	0.998569	11.56	7.1607
44	483.000	[illegible]	1.218	0.994887	11.88	7.4821
45	485.000	[illegible]	1.232	0.992103	12.13	8.2455
46	487.000	1.245	1.248	0.996939	12.47	9.2293
47	489.000	1.267	1.266	0.992675	13.02	12.4107
48	490.500	1.287	1.285	0.994129	13.56	15.3625
49	492.000	1.303	1.310	0.994626	14.02	19.0262
50	493.500	1.343	1.341	0.992661	15.29	27.2023
51	494.000	1.353	1.354	0.994840	15.64	33.2106
52	494.500	1.366	1.372	0.993582	16.11	38.4982
53	495.000	1.392	1.390	0.998023	17.14	47.8503
54	495.300	1.406	1.405	0.973303	17.73	68.4047
55	495.600	1.421	1.427	0.935623	18.41	114.2865
56	495.800	1.435				
57	496.000	1.474				
58	496.100	1.518				

6 AUGUST 1984

SPECIMEN NO. 2NC[illegible] AUTOMATIC

Pmax = 600 LBF   Pmin = 60 LBF   R = 0.100

B=0.494 in.   W=2.052 in.

PT #	CYCLE COUNT	A-cor in	A-reg in	MC	deltaK KSI√in	da/dn uin/cy
1	0.001	0.556				
2	42.530	0.573				
3	93.210	0.588				
4	143.710	0.604	0.605	0.999533	4.23	0.3325
5	187.150	0.619	0.619	0.999649	4.31	0.3372
6	272.230	0.650	0.649	0.999725	4.48	0.3500
7	319.970	0.665	0.666	0.999776	4.56	0.3545
8	358.870	0.680	0.680	0.999724	4.65	0.3585
9	405.410	0.696	0.696	0.999306	4.74	0.3748
10	445.470	0.711	0.711	0.999292	4.83	0.3967
11	485.600	0.726	0.726	0.997207	4.93	0.4576
12	517.940	0.742	0.741	0.998268	5.03	0.5177
13	552.420	0.757	0.760	0.998839	5.12	0.5908
14	594.710	0.788	0.787	0.998388	5.33	0.6785
15	615.450	0.803	0.802	0.997759	5.43	0.7432
16	638.400	0.819	0.820	0.997922	5.54	0.8073
17	659.330	0.834	0.836	0.998466	5.65	0.8576
18	671.980	0.849	0.847	0.998523	5.76	0.9096
19	689.720	0.865	0.864	0.997450	5.88	1.0217
20	706.490	0.880	0.881	0.994632	6.00	1.2045
21	719.920	0.896	0.897	0.998222	6.13	1.3882
22	729.680	0.911	0.912	0.996682	6.26	1.4686
23	737.800	0.927	0.925	0.998003	6.40	1.5650
24	743.760	0.942	0.941	0.998496	6.53	1.6606
25	758.670	0.958	0.959	0.996749	6.68	1.8004
26	766.960	0.973	0.974	0.998849	6.82	1.9190
27	774.510	0.988	0.989	0.998943	6.97	2.1628
28	780.580	1.004	1.003	0.999071	7.12	2.2399
29	788.330	1.019	1.020	0.999160	7.29	2.3717
30	793.760	1.034	1.034	0.99822[illegible]	7.46	2.3531
31	800.3[illegible]0	1.050	1.050	0.99920[illegible]	7.64	2.3118
32	805.2[illegible]0	1.065	1.064	0.998908	7.82	2.3335
33	814.1[illegible]0	1.080	1.081	0.98972[illegible]	8.01	2.4648
34	821.0[illegible]0	1.096	1.097	0.983245	8.[illegible]	3.1095
35	827.4[illegible]0	1.111	1.11[illegible]	0.969303	8.42	4.2772
36	829.1[illegible]0	1.126	1.1[illegible]	0.9667[illegible]	8.63	4.27[illegible]
37	832.1[illegible]0	1.14[illegible]	1.1[illegible]	[illegible]	8.87	4.[illegible]07
38	[illegible]	1.157	1.1[illegible]	[illegible]31	9.10	5.[illegible]
39	[illegible]	1.17[illegible]	1.174	[illegible]	9.35	5.41[illegible]
40	842.1[illegible]0	1.1[illegible]	1.1[illegible]	[illegible]	9.[illegible]	5.7047
41	[illegible]	1.20[illegible]	1.2[illegible]	[illegible]	9.[illegible]	5.[illegible]
42	846.[illegible]	1.219	1.21[illegible]	[illegible]	10.1[illegible]	[illegible]
43	[illegible]	1.2[illegible]				
44	852.[illegible]10	1.[illegible]				
45	[illegible]	1.2[illegible]				

6 AUGUST 1984

SPECIMEN NO. 2HC2 MANUAL

Pmax = 600 LBF Pmin = 60 LBF R = 0.100

B=0.494 in. W=2.052 in.

PT #	CYCLE COUNT	A-cor in	A-reg in	MC	deltaK KSI√in	da/dn uin/cy
1	0.001	0.558				
2	60.000	0.569				
3	120.000	0.557				
4	160.000	0.596	0.595	0.998610	4.18	0.2854
5	200.000	0.607	0.607	0.998503	4.24	0.3198
6	240.000	0.620	0.621	0.998067	4.31	0.3384
7	280.000	0.633	0.634	0.997868	4.38	0.3446
8	320.000	0.651	0.649	0.998530	4.48	0.3557
9	360.000	0.663	0.663	0.996987	4.55	0.3753
10	400.000	0.677	0.678	0.996988	4.63	0.3961
11	435.000	0.690	0.691	0.998838	4.71	0.4122
12	470.000	0.708	0.706	0.998397	4.82	0.4621
13	500.000	0.721	0.721	0.998405	4.89	0.5050
14	530.000	0.734	0.736	0.998349	4.98	0.5572
15	560.000	0.754	0.753	0.999380	5.10	0.6301
16	585.000	0.769	0.770	0.998950	5.20	0.6870
17	610.000	0.787	0.788	0.999335	5.32	0.7476
18	635.000	0.809	0.807	0.999307	5.47	0.8051
19	660.000	0.827	0.828	0.999383	5.60	0.8655
20	680.000	0.845	0.846	0.999285	5.73	0.9013
21	700.000	0.865	0.864	0.998850	5.88	0.9895
22	715.000	0.879	0.879	0.998754	5.99	1.0582
23	730.000	0.893	0.895	0.998771	6.11	1.1406
24	745.000	0.914	0.912	0.999154	6.28	1.2556
25	755.000	0.925	0.925	0.999143	6.36	1.3361
26	765.000	0.939	0.939	0.999290	6.50	1.4298
27	775.000	0.954	0.953	0.999580	6.64	1.5293
28	785.000	0.969	0.969	0.999583	6.78	1.6874
29	795.000	0.985	0.987	0.999364	6.95	1.8073
30	805.000	1.007	1.006	0.999166	7.17	1.9915
31	810.000	1.016	1.016	0.999113	7.26	2.0862
32	815.000	1.025	1.027	0.998998	7.36	2.1734
33	820.000	1.038	1.037	0.999162	7.51	2.2883
34	827.000	1.054	1.054	0.999218	7.69	2.5957
35	832.000	1.066	1.067	0.999254	7.84	2.8529
36	837.000	1.082	1.082	0.999680	8.04	3.0775
37	842.000	1.098	1.098	0.999389	8.25	3.2936
38	847.000	1.116	1.115	0.993486	8.49	3.9303
39	850.000	1.126	1.127	0.992644	8.63	4.0839
40	853.000	1.136	1.140	0.993830	8.78	4.3362
41	856.000	1.158	1.153	0.994109	9.12	4.6032
42	860.500	1.174	1.175	0.994395	9.38	5.0114
43	863.500	1.190	1.191	0.994267	9.65	5.1152
44	866.500	1.205	1.205	0.998230	9.92	5.4454
45	868.000	1.216	1.214	0.998181	10.12	5.8212
46	871.000	1.230	1.231	0.997879	10.40	6.5012
47	874.000	1.251	1.253	0.990966	10.83	6.4401
48	875.500	1.263	1.263	0.990562	11.09	6.3869
49	877.500	1.281	1.276	0.976217	11.50	7.1767
50	880.500	1.292	1.296	0.978791	11.76	8.4476
51	882.000	1.303	1.307	0.964092	12.04	10.6307
52	883.500	1.327	1.323	0.995953	12.67	13.6496
53	885.000	1.342	1.346	0.993972	13.10	18.1133
54	886.000	1.364	1.364	0.965094	13.77	26.5601
55	887.000	1.385				
56	887.500	1.403				
57	888.000	1.445				

30 AUGUST 1984

SPECIMEN NO. 3HCS MANUAL

Pmax = 800 LBF Pmin = 80 LBF R = 0.100

B=0.495 in. W=1.999 in.

PT #	CYCLE COUNT	A-cor in	A-reg in	MC	deltaK KSI√in	da/dn uin/cy
1	0.001	0.565				
2	40.000	0.577				
3	80.000	0.591				
4	120.000	0.608	0.607	0.999543	5.85	0.3966
5	155.000	0.622	0.621	0.991956	5.95	0.4702
6	190.000	0.637	0.637	0.994319	6.07	0.5333
7	225.000	0.652	0.655	0.995305	6.19	0.6547
8	260.000	0.684	0.680	0.997127	6.45	0.8233
9	290.000	0.702	0.706	0.997795	6.60	1.0002
10	320.000	0.739	0.739	0.997598	6.92	1.2082
11	345.000	0.770	0.769	0.998645	7.20	1.4687
12	365.000	0.799	0.802	0.998059	7.48	1.6976
13	375.000	0.817	0.819	0.999347	7.66	1.9640
14	382.000	0.833	0.833	0.997996	7.82	2.3415
15	387.000	0.844	0.844	0.996874	7.95	2.4652
16	392.000	0.855	0.856	0.994074	8.07	2.4885
17	397.000	0.874	0.871	0.994352	8.18	2.5500
18	402.000	0.884	0.883	0.994419	8.39	2.6286
19	407.000	0.894	0.896	0.992363	8.51	2.8000
20	412.000	0.909	0.908	0.999585	8.69	3.0420
21	417.000	0.924	0.924	0.999484	8.88	3.6657
22	422.000	0.944	0.944	0.999212	9.14	4.4919
23	425.000	0.957	0.956	0.999633	9.32	4.9316
24	431.000	0.990	0.990	0.998916	9.79	5.8077
25	434.000	1.011	1.009	0.998891	10.12	6.2193
26	436.000	1.022	1.022	0.998759	10.29	6.2699
27	438.000	1.033	1.035	0.998342	10.47	6.4033
28	440.000	1.049	1.047	0.998752	10.75	6.5179
29	442.000	1.060	1.061	0.998939	10.94	6.8293
30	444.000	1.074	1.074	0.996713	11.20	7.5179
31	446.000	1.089	1.088	0.999079	11.48	8.2759
32	448.000	1.104	1.106	0.999257	11.78	9.5272
33	450.000	1.127	1.126	0.999462	12.27	11.0544
34	451.500	1.143	1.143	0.998873	12.63	11.9353
35	453.000	1.162	1.163	0.999255	13.08	12.4994
36	454.000	1.177	1.175	0.999036	13.45	12.6751
37	455.000	1.188	1.188	0.999373	13.74	13.0732
38	456.000	1.201	1.201	0.997870	14.09	13.4771
39	457.000	1.214	1.213	0.997921	14.46	14.2703
40	459.000	1.242	1.245	0.998013	15.31	16.1981
41	459.500	1.254	1.254	0.998141	15.70	19.2197
42	460.000	1.265	1.263	0.998199	16.07	20.6072
43	460.500	1.275	1.275	0.997878	16.43	21.7858
44	461.000	1.284	1.286	0.998185	16.76	21.5044
45	462.000	1.310	1.307	0.997035	17.77	22.3103
46	463.000	1.328	1.330	0.996783	18.53	24.5519
47	463.500	1.340	1.342	0.996291	19.07	26.7072
48	454.000	1.356	1.354	0.995510	19.84	32.0813
49	464.500	1.370	1.368	0.962824	20.54	47.0036
50	465.000	1.387				
51	465.500	1.417				
52	465.800	1.469				

6 SEPT 1984

SPECIMEN NO. 3MC1 AUTOMATIC

Pmax = 850 LBF   Pmin = 85 LBF   R = 0.100

B=5.473 in.   W=3.050 in

PT #	CYCLE COUNT	A-cor in	Ameq in	MC	deltaK KSI√in	da/dn μin/cy
1	0.001	0.555				
2	127.470	0.571				
3	205.780	0.586				
4	268.050	0.602	0.601	0.999850	6.25	0.2626
5	324.700	0.617	0.617	0.999630	6.37	0.3023
6	372.900	0.632	0.633	0.999702	6.49	0.3307
7	416.460	0.648	0.648	0.999714	6.62	0.3578
8	455.780	0.663	0.663	0.999787	6.74	0.3785
9	496.950	0.678	0.679	0.999753	6.87	0.4008
10	533.910	0.694	0.693	0.998949	7.01	0.4337
11	571.600	0.709	0.710	0.999310	7.14	0.4726
12	602.880	0.724	0.725	0.998935	7.28	0.4981
13	628.990	0.740	0.738	0.998704	7.43	0.5318
14	657.830	0.755	0.754	0.998837	7.57	0.5747
15	687.410	0.770	0.772	0.998860	7.71	0.6095
16	709.810	0.786	0.785	0.999293	7.87	0.6549
17	732.130	0.801	0.800	0.999300	8.02	0.7139
18	755.040	0.816	0.817	0.996198	8.18	0.8202
19	773.000	0.832	0.832	0.993253	8.35	1.0208
20	790.760	0.847	0.851	0.992997	8.52	1.3776
21	801.020	0.863	0.865	0.995329	8.70	1.7914
22	809.460	0.878	0.878	0.998687	8.87	2.0693
23	815.190	0.893	0.894	0.990177	9.05	2.2243
24	820.920	0.909	0.907	0.999075	9.25	2.3677
25	827.730	0.924	0.924	0.998519	9.44	2.5170
26	834.340	0.939	0.940	0.997673	9.64	2.7611
27	839.970	0.955	0.955	0.999681	9.86	3.0822
28	844.650	0.970	0.970	0.999777	10.07	3.3895
29	848.570	0.985	0.984	0.999040	10.29	3.7945
30	852.850	1.001	1.001	0.998511	10.53	4.3312
31	856.680	1.016	1.018	0.998283	10.77	5.0765
32	859.210	1.031	1.030	0.997886	11.01	6.0029
33	862.010	1.047	1.048	0.996877	11.28	6.6684
34	864.070	1.062	1.063	0.996340	11.55	6.9150
35	865.620	1.078	1.074	0.996306	11.84	7.2389
36	868.130	1.093	1.094	0.997013	12.13	7.4330
37	870.390	1.108	1.110	0.996827	12.43	7.1860
38	872.040	1.124	1.121	0.993903	12.76	7.4159
39	874.340	1.139	1.138	0.990783	13.09	8.3993
40	876.770	1.154	1.159	0.989513	13.43	10.6348
41	877.760	1.170	1.169	0.989847	13.81	10.7421
42	879.020	1.185	1.184	0.989141	14.19	11.3989
43	879.920	1.200	1.197	0.995324	14.58	12.6387
44	881.700	1.216				
45	882.900	1.231				
46	883.830	1.246				

10 SEPT. 1984

SPECIMEN NO. 3LC2 AUTOMATIC

Pmax = 1050 LBF   Pmin = 105 LBF   R = 0.100

B=0.473 in.   W=2.049 in.

PT #	CYCLE COUNT	A-cor in	A-reg in	MC	deltaK KSI√in	da/dn μin/cy
1	0.001	0.536				
2	17.500	0.551				
3	32.260	0.566				
4	41.230	0.582	0.579	0.996008	7.53	1.2302
5	53.500	0.597	0.595	0.995468	7.67	1.3683
6	67.550	0.612	0.615	0.994753	7.82	1.5429
7	76.470	0.628	0.628	0.994854	7.98	1.8663
8	84.350	0.643	0.643	0.993550	8.13	2.3840
9	92.110	0.658	0.662	0.993781	8.28	2.8303
10	95.800	0.674	0.673	0.993754	8.45	3.0184
11	99.480	0.689	0.685	0.993810	8.61	3.1873
12	105.240	0.704	0.706	0.996349	8.78	3.4732
13	109.620	0.720	0.720	0.998167	8.95	3.5348
14	114.120	0.735	0.736	0.999372	9.12	3.7205
15	117.580	0.750	0.749	0.999715	9.30	3.9483
16	121.680	0.766	0.766	0.999371	9.49	4.0449
17	125.330	0.781	0.781	0.999742	9.67	4.1358
18	128.860	0.797	0.796	0.984399	9.87	4.6257
19	132.800	0.812	0.814	0.969466	10.06	6.0726
20	136.310	0.827	0.837	0.971606	10.26	7.2734
21	136.750	0.843	0.840	0.970039	10.47	7.0618
22	138.040	0.858	0.851	0.973272	10.68	7.6290
23	140.990	0.873	0.875	0.979195	10.89	7.5911
24	143.020	0.889	0.889	0.996404	11.13	6.2930
25	145.630	0.904	0.903	0.996772	11.36	5.7586
26	148.080	0.919	0.917	0.989274	11.59	5.9411
27	151.910	0.935	0.939	0.969669	11.85	7.6493
28	154.100	0.950	0.956	0.974494	12.10	11.4294
29	155.290	0.965	0.969	0.983279	12.36	13.1081
30	155.720	0.981	0.975	0.983181	12.65	13.4561
31	156.850	0.996	0.994	0.991443	12.92	15.2028
32	158.220	1.011	1.013	0.965576	13.21	15.7095
33	159.110	1.027	1.026	0.995446	13.53	16.2237
34	160.190	1.042	1.045	0.995221	13.84	18.9324
35	160.690	1.058	1.054	0.984507	14.19	22.2649
36	161.680	1.073	1.079	0.969686	14.53	32.8796
37	162.160	1.088	1.095	0.977532	14.88	51.6801
38	162.380	1.104	1.106	0.987862	15.27	73.6039
39	162.550	1.119	1.118	0.995951	15.65	92.8043
40	162.750	1.134	1.138	0.995944	16.05	111.4331
41	162.830	1.150	1.147	0.990861	16.50	129.8050
42	162.970	1.165	1.166	0.977915	16.93	181.0172
43	163.080	1.180	1.189	0.954631	17.39	305.4861
44	163.130	1.197	1.206	0.953780	17.94	498.4327
45	163.150	1.213				
46	163.180	1.233				
47	163.390	1.251				

7 SEPT. 1984

SPECIMEN NO. 3LC3 AUTOMATIC

Pmax = 950 LBF Pmin = 95 LBF R = 0.100

B=0.468 in. W=2.052 in

RD #	CYCLE COUNT	A-cor in	A-reg in	MC	deltaK KSI√in	da/dn μin/cy
1	0.001	0.538				
2	46.950	0.554				
3	85.750	0.569				
4	120.780	0.584	0.587	0.992590	6.89	0.6349
5	144.630	0.600	0.602	0.996079	7.03	0.8086
6	161.740	0.615	0.616	0.999207	7.16	0.9411
7	173.910	0.630	0.628	0.999290	7.30	1.0511
8	215.160	0.676	0.678	0.999089	7.73	1.4428
9	234.000	0.707	0.707	0.997698	8.04	1.7940
10	243.260	0.722	0.725	0.997245	8.19	2.1082
11	251.220	0.738	0.741	0.996459	8.36	2.5829
12	255.580	0.753	0.752	0.998395	8.52	2.8281
13	261.280	0.769	0.769	0.996948	8.69	3.3561
14	265.250	0.784	0.783	0.996968	8.86	3.6736
15	270.180	0.799	0.802	0.996907	9.03	3.9295
16	272.750	0.815	0.812	0.995800	9.21	4.2700
17	276.620	0.830	0.829	0.995127	9.39	4.8093
18	280.450	0.845	0.849	0.993588	9.58	5.0141
19	282.670	0.861	0.860	0.994110	9.78	5.0005
20	285.000	0.876	0.873	0.995574	9.98	5.2178
21	288.710	0.891	0.892	0.994987	10.18	5.4119
22	291.720	0.907	0.908	0.997961	10.40	5.4683
23	294.480	0.922	0.922	0.998889	10.62	5.9924
24	296.620	0.937	0.936	0.998605	10.84	6.3232
25	299.460	0.953	0.955	0.998620	11.08	6.7371
26	301.100	0.968	0.967	0.997559	11.32	6.6858
27	303.570	0.983	0.983	0.993125	11.56	7.0093
28	305.650	0.999	0.997	0.990667	11.84	7.6166
29	308.520	1.014	1.019	0.993711	12.10	8.9960
30	309.530	1.030	1.028	0.994775	12.39	9.8721
31	311.080	1.045	1.044	0.995150	12.68	11.7338
32	312.470	1.060	1.062	0.994878	12.97	12.5187
33	313.650	1.076	1.077	0.996219	13.30	13.0936
34	314.410	1.091	1.087	0.994275	13.63	14.2943
35	315.880	1.106	1.109	0.980701	13.96	18.0918
36	316.810	1.122	1.126	0.960978	14.33	27.9702
37	317.420	1.137	1.144	0.977254	14.70	36.9565
38	317.660	1.152	1.152	0.978434	15.08	40.3928
39	317.800	1.168	1.160	0.980990	15.51	42.8170
40	318.360	1.183	1.186	0.982153	15.93	48.0537
41	318.640	1.198	1.197	0.975220	16.37	56.7927
42	318.980	1.214	1.218	0.979087	16.86	81.9058
43	319.190	1.229				
44	319.250	1.245				
45	319.360	1.260				

29 AUGUST 1984

SPECIMEN NO.   3HCJ MANUAL

Pmax = 600 LBF   Pmin = 60 LBF   R = 0.100

B=0.474 in.   W=2.051 in

PT #	CYCLE COUNT	A-corr in	A-reg in	MC	deltaK KSI√in	da/dn µin/cy
1	0.001	0.553				
2	90.000	0.567				
3	180.000	0.580				
4	270.000	0.589	0.590	0.997935	4.32	0.1381
5	360.000	0.602	0.603	0.998619	4.40	0.1327
6	450.000	0.616	0.614	0.991973	4.48	0.1579
7	540.000	0.629	0.628	0.992845	4.55	0.1904
8	630.000	0.641	0.645	0.995090	4.62	0.2410
9	720.000	0.669	0.668	0.998295	4.78	0.3033
10	800.000	0.693	0.694	0.998624	4.93	0.3747
11	870.000	0.725	0.723	0.999031	5.13	0.4343
12	920.000	0.744	0.746	0.998627	5.25	0.4999
13	960.000	0.766	0.767	0.998224	5.40	0.5484
14	985.000	0.779	0.780	0.998606	5.49	0.5821
15	1010.000	0.797	0.795	0.994405	5.62	0.6797
16	1030.000	0.808	0.809	0.995031	5.70	0.7296
17	1050.000	0.820	0.824	0.995307	5.79	0.8166
18	1070.000	0.844	0.840	0.995233	5.97	0.8843
19	1090.000	0.858	0.860	0.995339	6.08	0.9216
20	1105.000	0.876	0.875	0.996683	6.23	0.8805
21	1120.000	0.889	0.888	0.995470	6.34	0.8246
22	1135.000	0.901	0.900	0.994964	6.44	0.8318
23	1155.000	0.913	0.915	0.996902	6.54	0.8320
24	1170.000	0.927	0.926	0.993425	6.67	0.9949
25	1185.000	0.940	0.940	0.995953	6.79	1.2460
26	1200.000	0.957	0.960	0.997581	6.96	1.5583
27	1215.000	0.986	0.986	0.999408	7.25	2.1353
28	1225.000	1.008	1.009	0.998323	7.49	2.7313
29	1230.000	1.021	1.023	0.997826	7.63	2.9334
30	1235.000	1.037	1.038	0.997573	7.82	3.2323
31	1240.000	1.058	1.055	0.997388	8.07	3.5643
32	1245.000	1.071	1.074	0.997086	8.24	3.9109
33	1248.000	1.085	1.085	0.996937	8.42	4.1900
34	1251.000	1.098	1.098	0.996262	8.60	4.2647
35	1254.000	1.112	1.112	0.999394	8.80	4.5000
36	1257.000	1.127	1.126	0.999381	9.02	4.4524
37	1260.000	1.138	1.139	0.999420	9.19	4.3810
38	1263.000	1.152	1.152	0.999080	9.42	4.3690
39	1266.000	1.165	1.164	0.999533	9.63	4.4048
40	1269.000	1.177	1.178	0.999384	9.84	4.4643
41	1272.000	1.192	1.191	0.997573	10.11	4.7143
42	1275.000	1.206	1.205	0.996113	10.37	5.2527
43	1278.000	1.218	1.221	0.995483	10.61	6.2121
44	1281.000	1.239	1.240	0.998370	11.04	7.8759
45	1282.500	1.252	1.252	0.999786	11.32	8.9448
46	1284.000	1.266	1.266	0.999989	11.64	9.9703
47	1285.500	1.282	1.281	0.991965	12.03	11.9167
48	1287.000	1.299	1.298	0.989817	12.46	14.8421
49	1289.000	1.324	1.332	0.952095	13.14	27.3839
50	1290.000	1.353	1.370	0.787949	14.07	181.5578
51	1290.500	1.369				
52	1291.000	1.418				
53	1292.000	2.051				

19 SEPT. 1984

SPECIMEN NO. 3HC2 MANUAL

Pmax = 850 LBF Pmin = 85 LBF R = 0.100

B=0.473 in. W=2.050 in

PT #	CYCLE COUNT	Acorr .in	Ameq in	MC	deltaK KSI√in	da/dn uin/cy
1	0.001	0.607				
2	50.000	0.627				
3	90.000	0.647				
4	120.000	0.671	0.672	0.999061	6.81	0.8578
5	140.000	0.689	0.689	0.999390	6.97	0.9770
6	150.000	0.700	0.700	0.998059	7.06	0.9535
7	160.000	0.711	0.710	0.998721	7.16	0.9685
8	175.000	0.726	0.725	0.997598	7.30	0.9835
9	190.000	0.738	0.738	0.997610	7.41	1.0055
10	205.000	0.752	0.753	0.998533	7.54	1.0532
11	220.000	0.770	0.770	0.998480	7.71	1.1189
12	230.000	0.783	0.781	0.998952	7.84	1.1787
13	240.000	0.793	0.793	0.997202	7.94	1.2854
14	250.000	0.805	0.806	0.998387	8.06	1.3598
15	260.000	0.819	0.820	0.998634	8.21	1.4619
16	270.000	0.837	0.836	0.997859	8.41	1.5118
17	277.000	0.847	0.847	0.998974	8.52	1.5177
18	284.000	0.858	0.857	0.995619	8.64	1.6025
19	291.000	0.867	0.867	0.996954	8.74	1.7296
20	298.000	0.878	0.879	0.998506	8.87	2.0048
21	305.000	0.894	0.894	0.998655	9.06	2.2886
22	312.000	0.912	0.912	0.994617	9.29	2.3894
23	317.000	0.927	0.925	0.995004	9.48	2.5826
24	322.000	0.939	0.938	0.991418	9.64	2.8151
25	327.000	0.947	0.952	0.991969	9.75	2.9212
26	332.000	0.967	0.967	0.990767	10.02	3.0187
27	335.000	0.980	0.977	0.991358	10.21	3.1138
28	341.000	0.996	0.997	0.995864	10.45	3.1446
29	344.000	1.004	1.005	0.996815	10.58	3.1312
30	347.000	1.014	1.014	0.998427	10.73	3.0556
31	350.000	1.025	1.024	0.998565	10.91	3.2215
32	353.000	1.034	1.033	0.997364	11.06	3.3451
33	359.000	1.052	1.053	0.998471	11.37	3.7529
34	365.000	1.076	1.077	0.999613	11.80	4.5434
35	368.000	1.092	1.091	0.999424	12.11	5.1572
36	371.000	1.106	1.107	0.998148	12.39	6.0091
37	374.000	1.124	1.125	0.997470	12.76	7.2763
38	376.000	1.139	1.140	0.996377	13.09	9.1590
39	378.000	1.157	1.159	0.997654	13.50	11.2260
40	379.000	1.169	1.170	0.997924	13.79	12.3471
41	380.000	1.186	1.182	0.984431	14.21	16.1019
42	381.000	1.197	1.198	0.987483	14.50	20.0907
43	382.000	1.212	1.218	0.986458	14.91	28.1631
44	383.000	1.249	1.248	0.995571	16.00	42.4884
45	383.500	1.266	1.271	0.996559	16.55	54.9031
46	383.800	1.289	1.289	0.993358	17.35	66.1556
47	384.100	1.306	1.312	0.961362	17.98	113.2044
48	384.200	1.317	1.323	0.939895	18.41	184.1710
49	384.300	1.329				
50	384.400	1.363				
51	384.450	1.393				

26 SEPT. 1984

SPECIMEN NO. 31C3

MANUAL

Pmax = 1050 LBF   Pmin = 105 LBF   R = 0.100

B=0.468 in.   W=2.051 in.

PT #	CYCLE COUNT	A-corr in	A-reg in	MC	deltaK KSI√in	da/dn μin/cy
1	0.001	0.587				
2	20.000	0.629				
3	30.000	0.654				
4	42.000	0.696	0.692	0.998708	8.77	3.1149
5	47.000	0.708	0.709	0.998976	8.90	3.1608
6	57.000	0.742	0.742	0.996490	9.29	3.5411
7	60.000	0.751	0.751	0.998176	9.40	3.6169
8	69.000	0.782	0.786	0.998078	9.77	4.1982
9	74.000	0.810	0.807	0.998440	10.13	4.7580
10	77.000	0.821	0.822	0.997394	10.27	5.3066
11	80.000	0.836	0.838	0.996250	10.47	5.7858
12	84.000	0.860	0.861	0.999275	10.81	7.2099
13	86.000	0.877	0.876	0.999062	11.05	8.3379
14	87.000	0.883	0.884	0.998936	11.14	8.8504
15	88.000	0.894	0.894	0.998511	11.31	9.3623
16	89.000	0.904	0.903	0.998222	11.46	9.7143
17	90.000	0.913	0.914	0.999656	11.60	10.1060
18	91.000	0.924	0.922	0.986732	11.78	11.2024
19	92.000	0.934	0.930	0.976759	11.94	14.3421
20	93.500	0.949	0.952	0.979999	12.19	25.5182
21	94.500	0.975	0.978	0.994562	12.65	37.1320
22	95.500	1.016	1.020	0.995546	13.43	55.8495
23	96.200	1.064	1.064	0.980846	14.45	82.3913
24	96.700	1.093	1.111	0.968728	15.13	121.4061
25	97.000	1.132	1.155	0.954722	16.13	199.2155
26	97.100	1.170	1.172	0.987104	17.22	308.7769
27	97.200	1.198				
28	97.250	1.231				
29	97.300	1.245				